SCIENTIFIC AMERICAN
No. SUPPLEMENT 886

Scientific American Supplement, Vol. XXXIV. No. 886.
Scientific American, established 1845.

NEW YORK, DECEMBER 24, 1892.

Scientific American Supplement, $5 a year.
Scientific American and Supplement, $7 a year.

ELECTRIC TRAMWAY AT PARIS.

WE recently announced that some electric street cars had begun running in Paris. We have just made a complete study of the arrangements adopted by the Tramway Co., of Paris, and the Department of the Seine, and so we are enabled to give a series of data obtained at the very source of the application.

The electric cars that have now been doing service for several months on the line from La Madeleine to Saint Denis are run by accumulators. The cars have accommodations for fifty passengers, have a covered roof, and are as comfortable as ordinary street cars, Fig. 1 gives a front view of a car taken at the moment of its arrival at Clichy Place.

The electric tramways that are operated by means of subterranean or aerial wires, with which the cars are connected all along the route, would have presented grave inconveniences in Paris. There was, therefore, no hesitation in adopting the system of accumulators that renders the car independent while running.

From an electrical point of view, the present system may be divided into three parts: the central station for charging the accumulators, the motors that actuate the cars and the apparatus that permit of operating the system.

The central station for charging the accumulators is located at Saint Denis. Three boilers, operating at a pressure of six kilogrammes per square centimeter, furnish steam to two Leconteux & Garnier horizontal engines of the Corliss type, giving 125 horse power at 75 revolutions per minute. These engines actuate an intermediate transmission that sets in motion two Desrozier dynamos of 60 kilowatts (260 volts and 230 amperes), at the angular velocity of 600 revolutions per minute. A special coupling permits of the actuating of a dynamo through one of the motors, the other remaining at rest. Alongside of the two horizontal engines there is a third one of the same type that runs at the rate of 180 revolutions a minute and actuates another dynamo. This engine serves as a substitute in case of accident. The cables starting from each dynamo are connected with the same distributing board. Each circuit comprises a disjunctor, an interrupter, fusible circuit breakers and a special amperemeter. Thence start separate circuits with special amperemeters for the charging of the accumulators. Thanks to such arrangements, it is possible at all times to ascertain the power of the dynamos, as well as the power absorbed for the charging of each battery.

The accumulators employed are of the Laurent-Cely type. They comprise 11 leaden plates of 200×200 millimeters, say a total active surface of positive plates of 40 square decimeters. The external dimensions of each accumulator are as follows: Height, 37 centimeters; length, 37 centimeters; width, 23 centimeters. During an ordinary running the charge should be 17·6 amperes, and, at a maximum, 35·2. Under the same conditions, the rate of discharge is 26·4 and 52·8 amperes. The effective capacity is normally 264 ampere hours, and 158 at a maximum run. The accumulators are placed in portable wooden boxes. There are nine of them to each box and three boxes constitute a battery. External contacts permit of establishing a communication through simple pressure. On each car there are four three-box batteries, say 4×3×9=108 elements. These batteries, placed under the seats, are introduced from the outside. Under each car are placed two dynamos, with either a Siemens or a Gramme armature, excited in series and actuating the wheels of the car through gearings. The electric motors take 200 volts and 50 amperes at the angular velocity of 1,500 revolutions per minute. The gearing brings the number of revolutions to the twelfth, say 108 per minute.

It will prove of interest to know how the various runnings—slow, rapid, and medium—are effected. In Paris street cars must, in fact, have variable speeds, according to the obstructions. Moreover, there has been imposed upon them a maximum of 7 miles per hour in the city and 9½ outside of the fortifications. All such variations of speed are obtained by coupling the accumulators and motors with each other. Let us hasten to say that such couplings are easily effected by means of accumulators arranged to this effect, the conductor having only to turn them in one direction or the other. Printed directions indicate the maneuvers to be effected according to the case. Three couplings of accumulators correspond to stoppage, high speed, and low speed.

For s stoppage, the four batteries of 27 accumulators are coupled in quantity, as shown in the diagram in

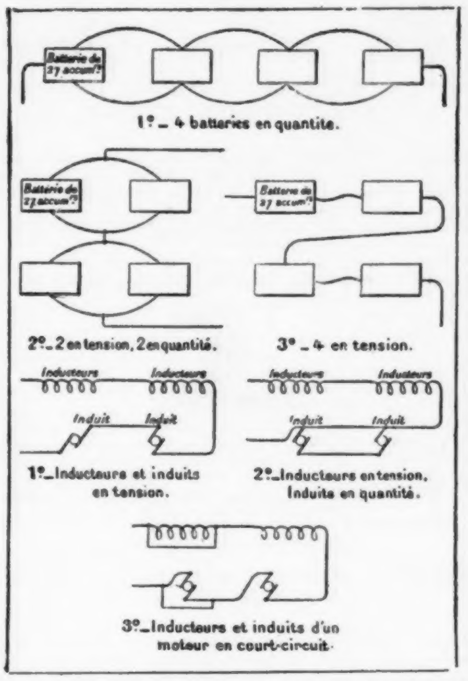


FIG. 2.—DIFFERENT METHODS OF COUPLING THE ACCUMULATORS AND MOTORS.

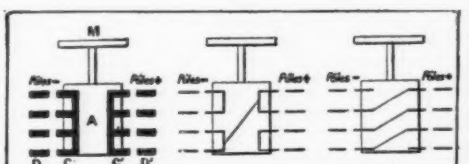


FIG. 3.—COUPLING APPARATUS OF THE ACCUMULATORS.

Fig. 2. The difference of potential is then 25 volts. For a maximum speed, two batteries are mounted in tension and two in quantity. Finally, for low speed, or ordinary running, the four batteries are coupled in tension. In the last case, the inductors and armatures of the motors are in tension. The armatures are coupled in quantity and the inductors in tension for stoppages and a maximum speed. It has likewise been necessary to provide for cases in which, for one reason or another, one of the motors may be out of service. To this effect, there are apparatus that permit of establishing short circuits upon the inductor and armature. In order to give a complete idea of things, we present in Fig. 3 a diagram of the coupling apparatus of the accumulators. It consists of a drum, A, actuated by an external winch, M. It carries copper contacts, C and C′, coupled either in quantity, say by 2's in tension and 2's in quantity, or 4's in tension, as represented in the diagrams. These copper contacts move opposite blocks, D and D′, at which end the extremity of the conductors of the various batteries of accumulators. Through a simple maneuver of the winch, the different couplings necessary are obtained.

Such are the principal arrangements adopted on the electric tramways of Paris. Let us add that the cars are provided with Lemoine brakes, that the commutators permit of reversing the direction of the cars' running, and that there are devices employed for preventing too strong sparks at the breakage of the current. —*La Nature.*

FIG. 1.—ELECTRIC STREET CAR AT PARIS.

AN IMPROVED OVERHEAD SYSTEM.

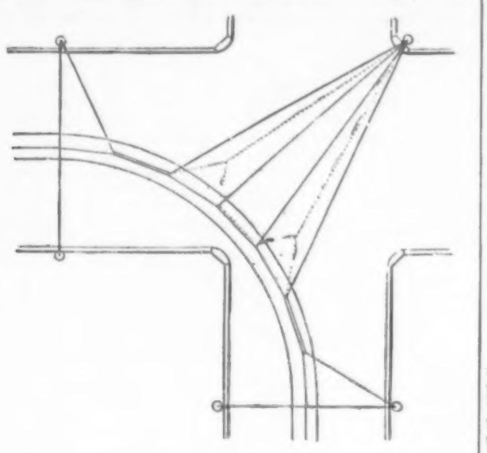
THE South Staffordshire Tramways have decided to adopt the overhead system of electric traction on a considerable portion of their system. The action of the directors was significant, because it was practically a recognition of the advantages of electricity compared with those of steam.

These tramways, having a mileage of twenty-three miles, are among the most important steam tramways in England. They practically fulfill the duties of a local railway between Walsall, Wednesbury, Darlaston, West Bromwich and other places in the neighborhood. Some four million passengers are annually carried between these places, but, as previously pointed out, the cost per car mile is heavy.

Very sharp curves and most severe grades are traversed on all parts of the route, the grades being in many cases as much as 1 in 16. Large sums have from time to time been spent upon the engines, and, as they were wearing out, it was resolved to adopt overhead traction. An arrangement was accordingly entered into with the Electric Construction Corporation to equip a large portion of the line for electric traction, to build a generating station, supply necessary plant, and maintain the system for a period of five years. The contract is at a certain fixed charge per car mile, but as a system of deferred payment has been adopted, it would be difficult to give figures which represented the actual cost per mile.

The length of line on which electric power will be used is about nine miles, which will be served by sixteen cars. The working conductor is simply suspended on arms attached to specially made steel columns, about twenty-one feet above footway. The length of arm carrying the conductor varies from two feet to five feet, according to the distance of the track and in case of stopping points. The arm of the column is stayed by a steel band, which is clearly seen in our illustrations. No matter how sharp may be the curve, no stays or cross wires whatever are employed. Even at a most awkward junction, known locally as the Fleck, the whole arrangement depends on the frogs and the steel columns. It would be unfair not to award some meed of praise to the designers of these steel columns. Where so much depends upon them it is very necessary that they should be of the highest caliber. Trouble was at first experienced in obtaining what was required, but Mr. Johnstone, of Messrs. James Russell & Son, Wednesbury, designed some fine specimens, and these are now used throughout the system. They are calculated to bend something like three feet without injury. The trolley wire is of 0 gauge, hand-drawn copper, divided into sections of approximately 880 yards in length. The feeders are insulated with vulcanized bitumen, lead sheathed and armored with a double layer of steel tape, the section being 0·25 square inch and 0·16 inch at the ends. They are carried underground from the station and are tapped at half-mile sections, fuses being inserted in the connections from the feeder to

the trolley wire. Each half-mile section of working conductor can be completely separated from the feeders without interfering with the working on other parts of the line, so that a fault arising on any part of the conductor would be practically localized. The return circuit is completed through the rails, the fishplates being so bonded and jointed that the whole forms a path of low resistance. The following drawings show the section of the fishplate and elevation of the connected rails. All repairs are made from the top of a movable scaffold, which is mounted on a dray. The columns bearing the conductor interfere little



AMERICAN SYSTEM OF STAYING A CORNER TROLLEY WIRE.

with the general aspect of the roads, and in cases where lamps are suspended they are a positive improvement on the old lamp posts.

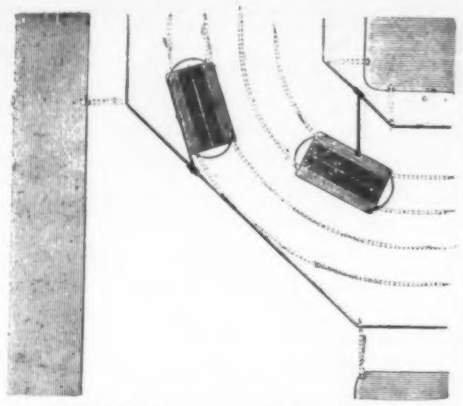
It must be remembered that the electric tram line runs not only through a country road, but through the streets of Walsall, Wednesbury and Darlaston. Their general unobstructive character may be gathered from our illustrations.

THE NEW SIDE COLLECTOR.

The whole system may be said to depend on the flexibility of the trolley mast or side collector. It is most agreeable to witness it take the sharpest curve and the most awkward switch, beautifully adjusting itself to all conditions of the road. The writer watched the collector in a few yards of road, at one moment some 12 in. over the body of the car and the next stretched out at right angles nearly 12 ft. away. A diagram shows the range of the collector pole. A is the maximum distance the trolley wire can be from the car, but it may vary in distance from A to B. The collector automatically engages the trolley wire in any position between these points. How easily it works in the case of a stopping point may be gathered from the following diagram.

CARS IN JUNCTION.

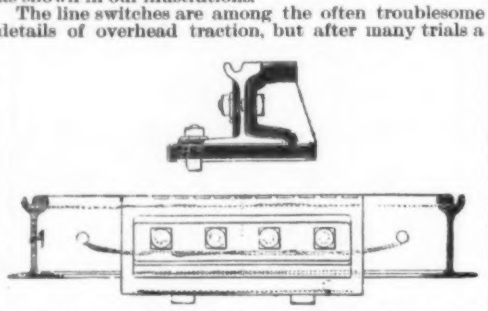
All that has been hitherto expected from a trolley was a play of some 2 or 3 ft., hence the costly and elaborate nature of overhead construction. In the Leeds line it was made compulsory that the trolley wire should not vary more than one inch from the center of the track. As previously explained, the flexibility of the mast being calculated to keep the wire in a lateral and vertical direction, the feed wire could be run at a direct tangent to the curve in the track without a semblance of uneven feed. The mast may be raised or lowered several feet if desired. The detailed drawings will enable our readers to see the simplicity of the working parts of the trolley. The mast part of the trolley, made usually of metal with a ball and socket arrangement, revolves on a metal rod placed in a metal tube. The radiation of the mast is controlled by means of springs fixed to a loose collar which works on the pedestal of the ball socket. The trolley is hinged to the mast so as to give it lateral play in any direction. The trolley wheels, which are of gun metal, $2\frac{1}{4}$ diameter, can, if required, be kept in position by



CARS ROUNDING A CORNER ON THE STAFFORDSHIRE METHOD.

means of guides which are intended to work upon a pivot or hinge, and are kept in position by springs which allow the guides to open on passing obstructions. In practice, however, it has been found that these guides are unnecessary, and the trolley is used as shown in our illustrations.

The line switches are among the often troublesome details of overhead traction, but after many trials a



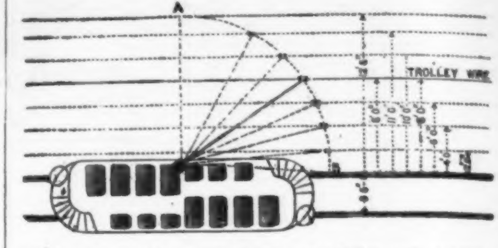
SECTION OF FISHPLATE AND ELEVATION OF CONNECTED RAILS.

form of switch has been adopted on the South Staffordshire line which, on the occasion of the writer's visit, worked admirably. The switch at first designed was about 2 in. below the conductor, and the trolley on passing practically jumped the switch, causing sparking. By means, however, of sweating sheet copper on the conductor and at each end of the switch, we have an arrangement similar to our drawing, which makes an easy run. All the newer line switches will be made in one piece.

Detailed drawings will show the component parts of the insulator. It is practically a bronze insulator, filled in with an insulating compound provided with mechanical clips. The screw which supports the conductor is firmly embedded in the insulating material and forms altogether a sound piece of work.

THE GENERATING STATION.

The generating station is situated midway between the two ends of the lines. It contains three shunt-wound dynamos, of the Electric Construction type, giving 350 volts and 260 amperes at 450 revolutions. They are driven by ropes from three Musgrave & Sons' engines of the horizontal compound side-by-side type, with rope drum between cylinders, each capable of indicating a normal working load of 125 I.H.P. when running at a speed of 100 revolutions per minute,

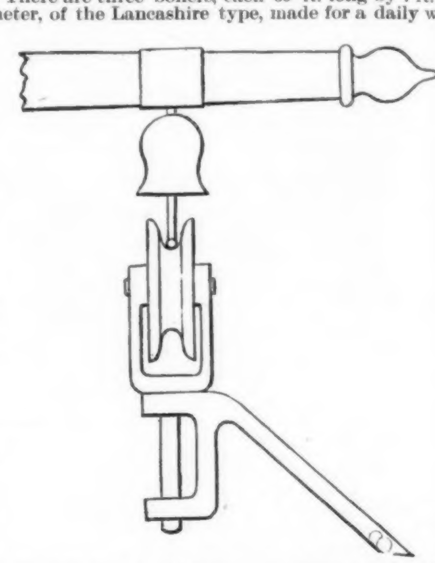


CAR ON LINE—SHOWING RANGE OF MAST.

with 120 lb. boiler pressure. Cylinders are $10\frac{1}{2}$ in. and 20 in. diameter by 2 ft. 6 in. stroke, and fitted with Corliss valves and Musgrave's patent automatic cut-off motion. The rope drums are 10 ft. in diameter, grooved for nine ropes, $1\frac{1}{4}$ in. diameter. The air pumps are of the horizontal type, with surface condensers.

Crank shafts are made of Siemens steel, with bearings, 6 in. diameter by 12 in. long, piston rods and crank pins are of the best mild steel, crossheads and connecting rods being made of forged iron. Governors are of the quick speed type driven by ropes from the crank shaft. The crank shafts and crank pins are provided with self-lubricating oiling arrangements.

There are three boilers, each 30 ft. long by 7 ft. diameter, of the Lancashire type, made for a daily work-

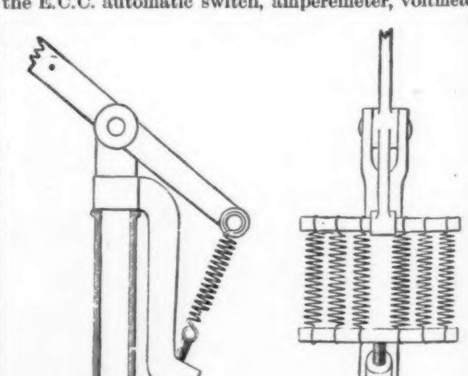


DETAILS OF TROLLEY—SHOWING TROLLEY WHEEL.

ing pressure of 120 lb. per square inch and tested by hydraulic pressure to 200 lb. per square inch. The flues are 2 ft. 9 in. diameter, with five conical tubes in each. The steam and feed pipes are arranged so as to give a duplicate service between the boilers, engines, and pumps.

Messrs. Musgrave & Sons have also supplied all the necessary pipes and valve connections for engines and boilers, also two donkey feed pumps for feeding the boilers.

Each dynamo has its own switchboard, on which is the E.C.C. automatic switch, amperemeter, voltmeter,



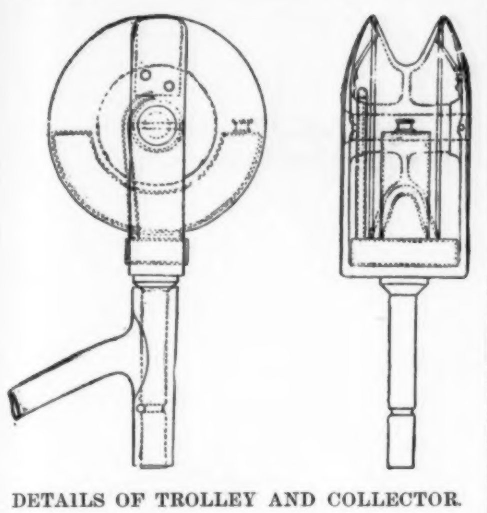
SECTION. PLAN.

DETAILS OF TROLLEY—SPRINGS CONTROLLING TROLLEY.

and regulating switch and resistance coils for shunt circuit. The machines are run in parallel into common omnibus bars. The station is conveniently situated on the banks of a canal from which water is taken for condensing purposes.

THE CARS.

The cars, which have been specially built for the new service, are 22 ft. long, and will carry forty passengers. They are mounted on a bogie carrying two motors. The motors are capable of developing 15 brake horse power, running approximately at 400 revolutions. They are series wound, the power being transmitted to the car axles by double helical cast steel wheels and



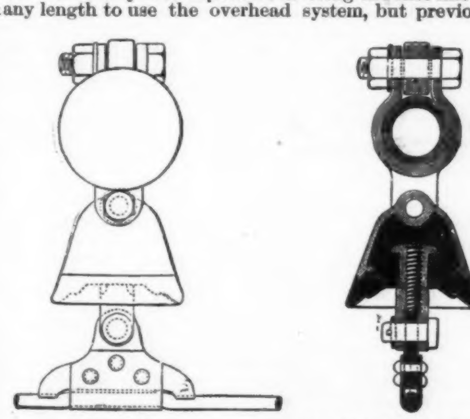
DETAILS OF TROLLEY AND COLLECTOR.

pinions having a radius of 4 to 1. One motor is easily capable of taking a fully loaded car up the heaviest grade on the line. They are fixed in dust-proof casing, and are easily detachable from the bogie. There are two sets of brakes on each car, one being applied to the inside edge of the wheel and the other on the outside. Each brake is worked separately. There are four dry sand boxes fitted on each car, two at each end. A complete set of switches is fitted at each end of the cars, and arranged so that either or both motors can be connected on the circuits. The speed of the motors is controlled by a multiple contact switch cutting resistance in or out of the motor circuit. The switching arrangements at each end of the car can only come into working on the interposition of a key,

LINE SWITCH.

which is carried solely by the driver. Each car will be provided with a lightning arrester, and will be lighted by electricity. The car, when fully equipped, weighs about six tons, which is about ten tons less than the steam car.

With this somewhat rough outline of the South Staffordshire Tramways Company's overhead system, we will conclude with complimenting the company generally, and Mr. Dickinson in particular, upon the manner in which the work has been designed. Nor should we omit to mention how well the work has been carried out by the Electric Construction Corporation under the personal supervision of Mr. Parker. The performance marks an epoch in English overhead traction. Not only is it important as being the first line of any length to use the overhead system, but previous



End elevation. Section of interior of insulator.

INSULATORS.

methods have been so much modified that, if success does attend the scheme, and we see little to doubt it, the overhead system ought speedily to meet with rapid development in England.—*The Electrical Review.*

THE SIEMENS & HALSKE ELECTRIC RAILWAY CONDUIT.

THE success attending the operation of the conduit system for electric railways in Buda-Pesth, the capital of Hungary, which has now been in operation since July, 1889, has been so encouraging that the promoters, Siemens & Halske, have decided to introduce the system in England through their American representatives, Wright & Meysenburg, of Chicago.

By the courtesy of this firm we are enabled to present our readers with the accompanying engravings, which illustrate very clearly the method of street construction which it is proposed to employ in order to adapt the system to the conditions prevailing in American practice. This construction, it will be noted, differs materially from that employed on the other side, and which was illustrated in the *Street Railway Journal* in July, 1891, but the essential features, and those to which the success of the system is largely due, have been retained, and these are the forms of the conductors, the method of mounting them, and the plow or trolley which conveys the current to the motors.

Two forms of construction are illustrated, the first of which is shown in Figs. 1 and 2, where the conduit is

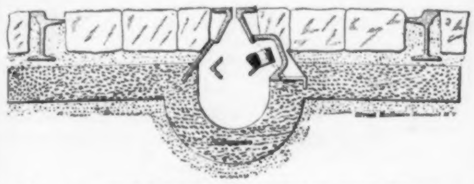


FIG. 1.—ELECTRIC RAILWAY CONDUIT—SECTION BETWEEN YOKES.

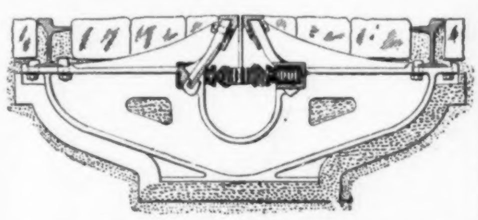


FIG. 2.—ELECTRIC RAILWAY CONDUIT—SECTION AT YOKES.

placed between the rails; the former is modeled after the designs employed in cable railway construction, being about 18 in. deep and 10½ wide, with manholes at intervals through which access may be had to the conductors.

The second form is shown in Fig. 3, in which case the conduits for a double track line are placed between the tracks, so that one yoke answers for both conduits, and an opening having a corrugated cover is provided the entire length of the line, by which access can be had to the conductors at any point. By this means the cost of construction is materially reduced, and being in the center of the street, it is not exposed to so much wagon traffic, and receives the drainage of but a limited surface. In this the plow will be mounted under the side of the car, and it will be necessary to turn the car at the ends of the line, either by means of a loop or a turntable.

The conductors, both for the positive and negative poles, consist of angle bars which are supported on either side of the tube, and provided with suitable expansion joints every 30 ft. The angle bars are supported by triple insulation, the supporting pin being insulated from the porcelain cup by means of a core of Siemens cement, and the porcelain from the yoke by a shell of the same material. The angular form of the conductors and the shape of the sliding trolley contacts prevent the trolley from jumping off the conductor and insure a continuous contact, regardless of the motion of the car up or down or sideways. Springs in the plow hold the contact plates firmly against the surface of the conductor, and through these plates and their connections the current is taken up from one pole, led up along the shank to the motors and returned to the other pole in the same manner.

A modified form of cable slot rail is employed, which has the inner face extending slightly below the angle

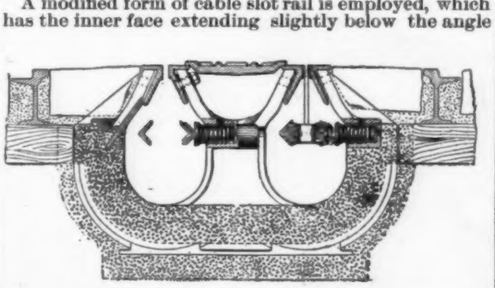


FIG. 3.—ELECTRIC RAILWAY CONDUIT FOR DOUBLE TRACK ROAD.

formed by the lower web, which serves to lead the drippings into the middle of the tube, and prevents the moisture from following the lower web and falling upon the conductors. The cost of the street construction will be about the same as for cable construction, but the economical results achieved in Europe in the operation of this system are so great that the saving in operating expenses would seem to warrant a liberal cutlay in roadbed and conduit construction.

From January 1, 1892, to June 30, 1892, the four conduit lines in Buda-Pesth carried 5,485,010 passengers. The cars traveled 630,648 miles. The total cost of operation was $58,039.63; the receipts $141,980.77, which shows that the road was operated for 40·8 per cent. of its receipts. The average receipts per passenger were 2·588 cts., and the expenses 1·056 cts. While the rate of wages is about one-half that of this country, the price of coal is about three times as great, and the rate of fare one-half. Hence it may be inferred that the operating expenses in the two countries will be about the same.

As this system employs a low voltage (only 300 volts), there is little liability of loss from leakage, and the possibility of burning out of armatures and fields of the motors is greatly reduced. An important economical feature of this system is the employment of large generators coupled direct to large engines. The practice in this country until recently has been the employment of a number of small generators driven direct by belts or from a countershaft; but the result of nearly fifty years' accumulated experience in general mechanics has satisfied Siemens & Halske that direct coupling as now practiced by them is the most economical, as all friction due to slip and tension is eliminated. In some types of the large generators, which are from 18 to 20 ft. in diameter, the armature revolves outside of the magnets. By this construction the necessary speed is obtained without excessive speed on the part of the engine. The commutators of these machines are very durable, being guaranteed for 20,000 hours, and in some instances have run eight years. In some cases further economical results are obtained by the use of storage batteries at the station in which surplus power is stored as a reserve.

In introducing the conduit system in this country the promoters propose to employ any of the leading types of motors now in use, but prefer motors of their own manufacture which will be made after the designs furnished by Siemens & Halske.—*Street Railway Journal.*

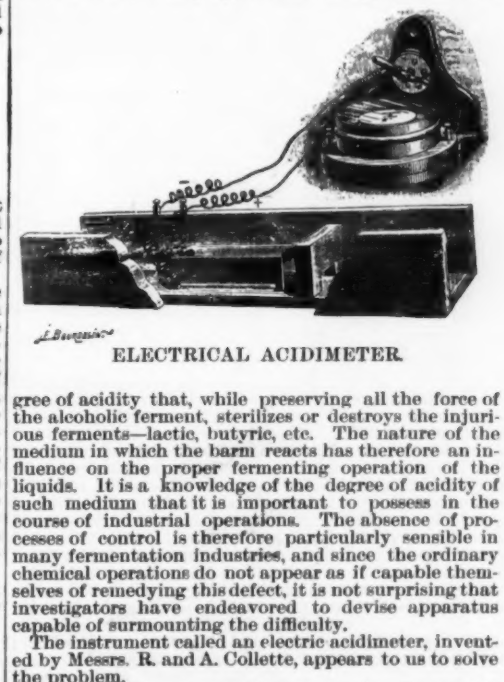
ELECTRIC ACIDIMETER.

ALONGSIDE of the important applications of electricity there are certain small inventions of insignificant appearance, which are nevertheless capable of rendering genuine services. We find a striking example of these in a very elementary apparatus now to be seen at the Exposition of Alcohols, at the Champ de Mars.

The determination of the degree of acidity in fermented beverages—wine, beer, cider, etc.—is quite an important operation, for which we have chemical processes of quantitative analysis that are capable of furnishing results of remarkable precision.

But in manufacturing, such methods of analysis and titration do not permit of following the phases of fermentation in measure as they succeed each other. From this point of view, they are inadequate and do not lend themselves to the constant control of the conditions of the acidity of the wort, which, to the distiller, is of a certain importance.

In practice, it is established that fermentation is so much the better in proportion as we approach the de-



ELECTRICAL ACIDIMETER.

gree of acidity that, while preserving all the force of the alcoholic ferment, sterilizes or destroys the injurious ferments—lactic, butyric, etc. The nature of the medium in which the barm reacts has therefore an influence on the proper fermenting operation of the liquids. It is a knowledge of the degree of acidity of such medium that it is important to possess in the course of industrial operations. The absence of processes of control is therefore particularly sensible in many fermentation industries, and since the ordinary chemical operations do not appear as if capable themselves of remedying this defect, it is not surprising that investigators have endeavored to devise apparatus capable of surmounting the difficulty.

The instrument called an electric acidimeter, invented by Messrs. R. and A. Collette, appears to us to solve the problem.

This apparatus is exceedingly simple. It consists essentially of a galvanic couple and of an indicating galvanometer. The electric element is composed of two metallic plates (copper and zinc) provided at the side with two longitudinal channels, and assembled by four insulated nuts fixed upon their angles and holding them in a parallel position. This couple, upon being immersed in any liquid that is somewhat acid, behaves like a true voltaic pile. The reaction of the acid upon the zinc gives rise to a current whose intensity is shown by a greater or less deflection of the needle of the sine-tangent galvanometer serving as an indicating apparatus.

The fundamental principle of this instrument in such conditions (supposing that we operate upon distillery liquids, and that we consequently tend to especially utilize the reactions of the organic acids set at liberty through the combination of the added sulphuric acid with the bases of the liquid) is as follows: A zinc-copper couple immersed in the acidulated water produces a current due to the dissolving of the zinc, and the constants of which are a function of Ohm's law, $I = \frac{E}{R}$. If, then, we admit that the acidity is feeble and always produced with the same acid, we may regard E as constant, although R is variable and proportional to the quantity of acid, so that I increases in measure as R diminishes. But when the acidity becomes strong, R is very feeble, so that I rapidly increases, and the deflection of a galvanometer needle does not increase much when a certain richness of acid is reached. In the Collette apparatus it is therefore very necessary that the acid richness shall be feeble—a condition that recommends it especially for beet juice, the acidity of which is figured by $\frac{8}{1000}$ or $\frac{6}{1000}$, calculated in SO_3HO.

The galvanometer used with this instrument possesses a dial graduated for currents corresponding to those that might be furnished by liquids of a very pronounced acidity, the middle graduation corresponding to a normal liquid.

The readings therefore furnish a means of automatically registering the acidity of saccharine liquids set in fermentation. They permit the distiller, for example, to constantly follow the variations of his wort in acidity. Seeing the principle of its operation, it is clear that this indicating galvanometer is capable of furnishing at a distance all the data that are expected of it. The use of two contacts, connected with an electric bell (as in some thermometers) at the extremities of its needle's travel, that is to say, at the points corresponding to the minimum and maximum of acidity, may very well complete, through an acoustic signal, the indications furnished by these galvanometers.

The accompanying figure shows the general arrangement of the apparatus. The couple is immersed either in the preparatory vats or else in the conduit that leads the liquid to the fermenting vats. As this liquid is constantly agitated, we have not to fear the effects of polarization, which would seem as if it ought necessarily to alter the precision of the readings transmitted.

A peculiar arrangement permits of remedying the accidental conditions in which it may happen that the couple is incompletely submerged, whence a decrease in the intensity of the current, and consequently a modification of the indication in an irregular manner. This arrangement consists in the establishment of a partition in the conduit in which the liquid circulates. This artifice obliges the liquid to rise to its upper level in order to flow over in great part and immerse the couple to a constant depth. The element is thus kept in invariable conditions that guarantee accurate readings. The liquid that surrounds it is also freed of its impurities by an aperture formed beneath the partition and through which the earth and gravel are eliminated.

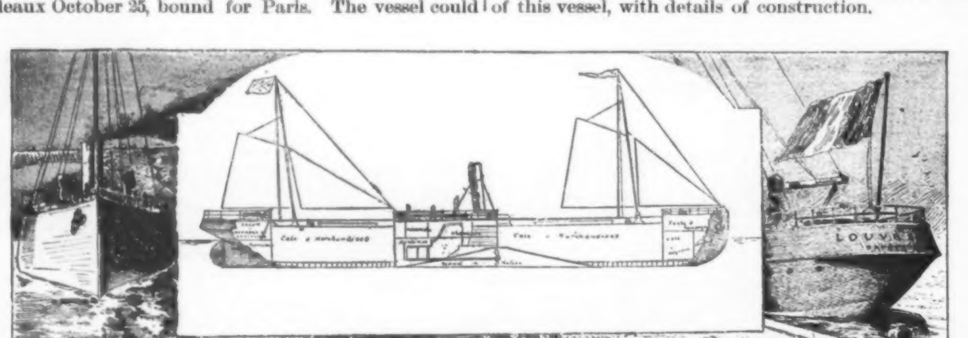
The electric acidimeter is employed particularly in distilleries of beets and molasses. It is met with in a number of works in France.—*Annales Industrielles.*

LOSS OF THE CENTRAL SCREW STEAMER LOUVRE.

The steamer Louvre, belonging to the Parisian Company, was cast on the coast of Point Penmarch, in front of the semaphore of Loctudy, during the night of October 28, 1892.

The crew of the Louvre consisted of eighteen men, under command of Captain Audureau, and left Bordeaux October 25, bound for Paris. The vessel could carry 800 tons of merchandise, and was constructed at Nantes in the ship yards of Mr. Oriolle. It made its first voyage to Paris in February, 1892, and was detained by the high water of the Seine, in spite of its light draught. It drew only 9 ft. when fully loaded. The Louvre measured 173 ft. in length and 26 ft. in width, and was propelled by two screws placed exactly in the center of the vessel. It was the first steamer constructed in this way. The two screws were operated by two entirely independent engines. The lifesaving boat from Lesconil, after great exertion, succeeded in saving the chief engineer and two sailors. The other men were drowned.

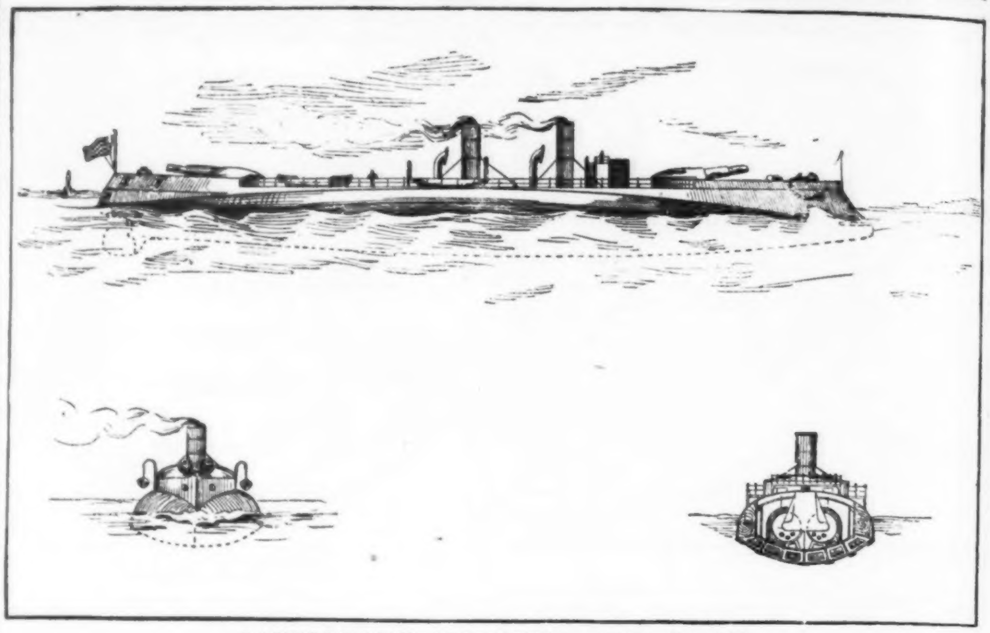
In the Scientific American Supplement, No. 880, will be found additional particulars and illustrations of this vessel, with details of construction.



LOSS OF THE CENTRAL SCREW STEAMER LOUVRE.

COMMODORE FOLGER'S GUN BOAT.

We are indebted to the U. S. government *Advertiser* for our illustration of the submarine gun boat designed by Commodore Folger. The design of the ship is due to the success attending the experiments with submarine guns—results which lead Commodore Folger to the recommendation that all rams be supplied with this type of ordnance. The proposed ship illustrates the application of submarine artillery as a primary element of the armament of a ram, at the same time utilizing high explosives propelled by a powder charge. The above-water guns are short-bored rifled mortars, firing projectiles of drawn or rolled nickel steel with bursting charges of 200 pounds of high explosives. The pair of submarine guns designed to be discharged in rapid succession are intended to use projectiles containing 500 pounds of high explosive. The curved nickel steel deck and submerged side armor, the last as a defense against the torpedo, present a combination of the elements of protection which is bound to prove effective.



COMMODORE FOLGER'S GUN BOAT.

THE NEW WAR SHIP BROOKLYN.

Under the appropriation for the increase of the navy, act approved July 19, 1892, provision is made for one armored cruiser of about 8,000 tons displacement, to cost, exclusive of armament and speed premiums, not more than $3,500,000. The principal dimensions are as follows: Length on load line, 400·50 feet; beam, extreme, 64·83 feet; draught, mean, normal, 24 feet; displacement, normal, 9,150 tons; displacement, trial, 8,150 tons; indicated horse power, 16,000; speed in knots per hour, 20; total coal capacity, 1,650 tons; coal carried on normal displacement, 900 tons.

This vessel will have twin screws, the engines to be of the vertical triple expansion type, four in number, two on each shaft and in four compartments. The forward engines to be readily uncoupled from the after engines for cruising and low speed. The boilers are placed in three compartments and are seven in number, five of them being double ended and two single ended. The hull is to be of steel, not sheathed, with double bottom and close watertight subdivision to about twelve feet above the water line. The arrangements of decks above water to provide ample freeboard and berthing accommodations. It is contemplated to fit two military masts with fighting tops, to carry no sail. The boats will be stowed clear of the blast of the guns, but two life boats must be so carried that they may be readily lowered under all conditions of weather. Protection of the hull is to be afforded by means of a steel protective deck worked from stem to stern and supported by heavy beams. The bottom edges of this deck, amidships, are to be five feet six inches below the twenty-four foot water line, the top of the deck rising to this water line at the center of the vessel.

On the slopes of the deck, over machinery and boilers, the armor is to be six inches thick. On the horizontal portions the armor is to be three inches thick; forward and abaft the machinery and boilers, to stem and to stern, the deck is to be at the thinnest part at least two and a half inches in thickness.

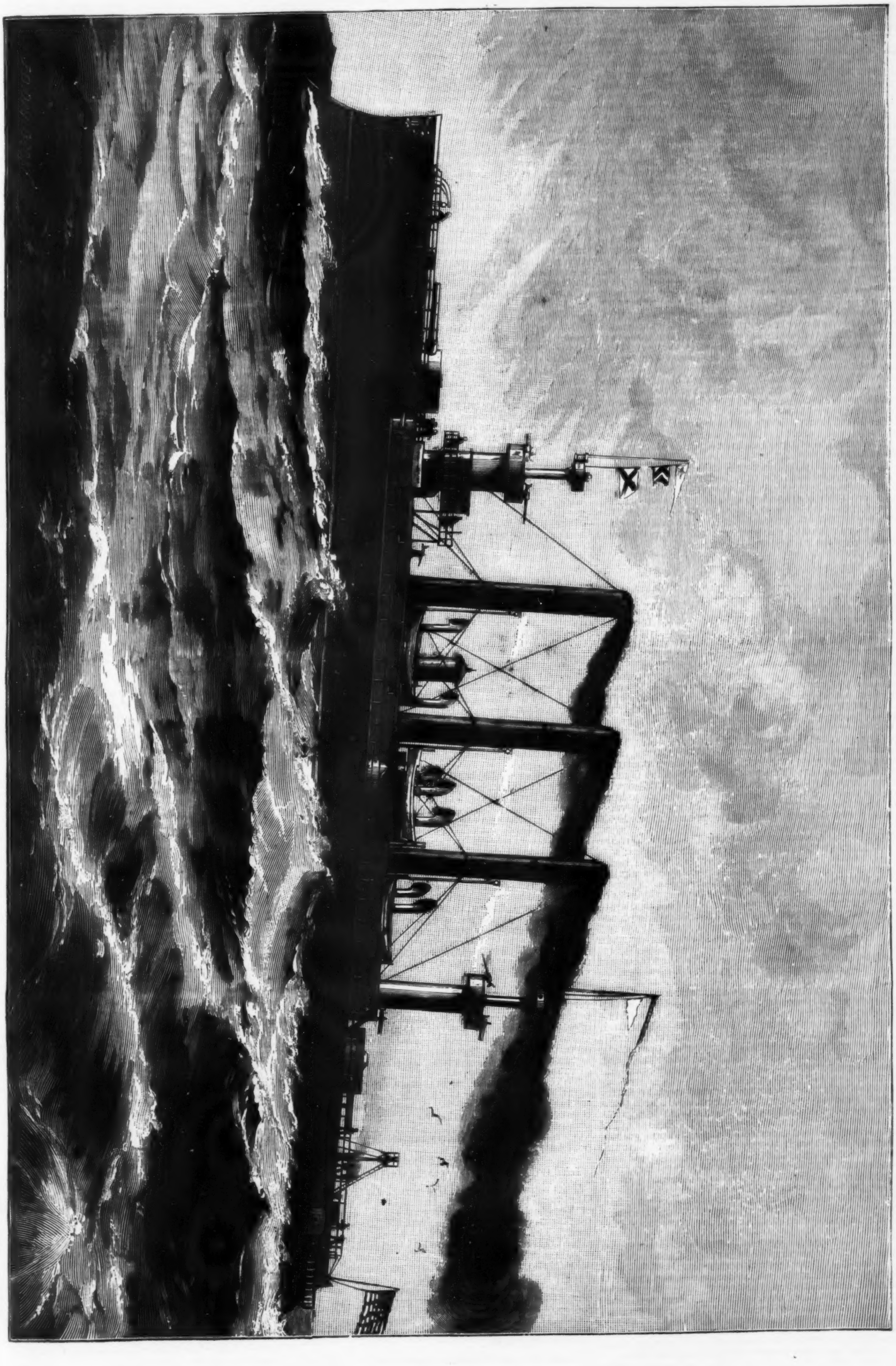
Below this deck are to be placed propelling machinery, steering gear, magazines, shell rooms and all that is ordinarily styled "the vitals of a war ship."

Protection of the hull from injury to the water line region is to be afforded by means of an armor belt three inches in thickness, extending the length of the machinery and boiler space, and in depth from four feet above the twenty-four foot water line to four feet three inches below that line.

Within this armor belt and skin plating, and above the armor of this belt, a band about three and a half feet wide of cellulose is to extend the whole length of the vessel, in depth from the armor deck to the berth deck.

It is intended to carry coal above the armor deck for a length corresponding to the inner bottom. This space between the armor deck and the deck above is to be subdivided by watertight bulkheads into at least thirty-six coal bunkers, exclusive of cofferdam and passages. The spaces forward and abaft these bunkers to be well subdivided into watertight bulkheads for stores, etc.

A conning tower of not less than 7½ in. in thickness is to be carried in a suitable commanding position, having a tube to the protective deck of not less than 5 in.



OUR NEW NAVY—ARMORED CRUISER "BROOKLYN," WITH HER 100-FOOT SMOKESTACKS.—SPEED, WITH NATURAL DRAUGHT, 25 MILES PER HOUR.

[Drawn Expressly for ONCE A WEEK by J. O. Davidson.]

in thickness for the protection of speaking tubes, bell wires, etc.

The battery of the vessel is to be: Eight 8 in. breech loading rifles of 35 caliber, twelve 5 in. (breech loading rifles) rapid fire guns, twelve 6 pounder rapid fire guns, four 1 pounder rapid fire guns, four machine guns, and two field guns.

The 8 in. guns will be mounted in four barbette turrets placed one forward and one aft on the center line of the vessel and one on either side of the vessel amidships. The guns in the turrets on the center line of the ship are to have a train of 310°; those in the side turrets to fire from right ahead to right astern are to train through an arc of 180° each. The center of side turrets to be distant from the center line of the vessel about 23 ft. The armor forming the barbettes, which will protect the carriages, platforms, and turret machinery, to be 8 in. in thickness for a portion at least equivalent to the train of the guns of the respective turrets; the remaining portions may be reduced to 4 in. in thickness. Under the turrets there will be placed 3 in. armor supporting tubes, which will also protect the ammunition hoist. All the armor of the turrets to be 5½ in. in thickness and the guns so mounted that they can be supplied with ammunition and loaded in any position of train.

The 5 in. guns are to be protected by fixed segmental shields, 4 in. in thickness. The crews of these guns are to be further protected from explosive shells by splinter bulkheads, 1½ in. in thickness. Protection to be afforded the smaller guns by shields and extra side plating.

The torpedo outfit is to consist of five torpedo tubes, one in the bow and two on each side, six torpedoes and a suitable allowance of gun cotton for mines and miscellaneous purposes. Provision is to be made for defense against torpedo attacks by means of steel ring nets carried on outrigger booms.

Distilling apparatus and evaporators will be fitted for fresh water supply, the allowance of water to be carried to be sufficient for fifteen days, besides water for sanitary purposes.

There will be an electric lighting plant, consisting of two divisions, each division having an engine and dynamo, and each dynamo having a rated output of 400 amperes at 80 volts.

The ship will have a radius of action at full speed of 1,192 knots, and a radius of action at 10 knots of 6,216 knots. Complement of officers and men will be 566 persons. Hull and fitting designed by bureau of construction and repair, under the direction of Chief Constructor T. D. Wilson, U. S. N., and the machinery by the bureau of steam engineering, under the direction of Engineer in Chief George W. Melville.

MINING INDUSTRY IN PERU.

SINCE the discovery of America the great fame of Peru has been well known, always united with the idea of opulence. This fame is due to the great quantities of the precious metals the Spaniards found accumulated in the country and the great number of mines discovered by them in the various districts.

Peru is divided by the range of the Andes Mountains into three separate zones, called *Costa*, *Sierra* and *Montana*. The first is comprised of the district between the mountain range and the Pacific coast. This is a barren, arid plain, only broken by a few hills, but it is intersected by several streams which flow to the sea through valleys of exceptional fertility.

The Sierra zone lies between the two main ranges of the Andes, called the coast and eastern range. These mountains reach to great altitudes, many peaks being as high as 18,000 ft. above the sea, and are perpetually covered with snow. The surface of this zone is much broken, but there are great table lands covered with grass where cattle are raised. There are some large lakes, and also profound valleys with luxuriant vegetation. The mean altitude of this zone is about 10,000 ft. and the climate is cold.

The Montana zone extends from the eastern range of the Andes to the eastern boundaries of Peru; it is covered with a virgin forest, and in it are the headwaters of the Amazon River. The climate is similar to that of the coast, perhaps a little warmer.

In the coast zone are found the great deposits of guano and in the southern part are the famous nitrate beds, now in the possession of Chile, in consequence of the war with that country some ten years ago.

The geological formation is crystalline or eruptive, in which minerals are not found; there are some few interruptions of sedimentary deposits in which are found silver, gold and copper ores, oxidized and chloridized.

In the northern part, between 3½° and 6° south latitude, are found immense deposits of petroleum, covering about 6,000 square miles. Petroleum is found at the depth between 100 and 300 feet, under beds of sand, sandstone, conglomerate and slate. Some of the wells produce from 75,000 to 100,000 gallons of oil per day.

Extending throughout this zone there are also found deposits of salt, sulphur, alunojen, borax and nitrates.

In the Sierra zone are found minerals with silver for a base, chiefly in a limestone formation, being the richest of the Jurassic period, and in veins intimately connected with the dioritic upheaval. Here is found great abundance of antimonial argentiferous galena, generally mixed with blende. There are also found copper ores in sandstone formations sulphidized and complex in their nature, and also gold in its native state, but more frequently in iron pyrites. A great part of the copper ores are also gold and silver bearing.

Mercury is found in its native state or as cinnabar. Coal of various classes is frequent, and recently petroleum has been discovered in this zone near Puno.

In the Montana zone on the eastern slope of the range of the Andes, that divides this from the Sierra, are found gold quartz veins intersecting the slates of the Silurian formation, veins which are the origin of the great alluvial deposits or placers, along the various streams which have their sources in this mountain range. This is the gold region of Peru, renowned as containing the great Carabaya and Sandia districts, which latter, according to a survey of a part of it, contains 11,021,000,000 cubic meters of gold-bearing sand, estimated to contain 1,834,000 kilogrammes of gold.

In the time of the Incas of Peru the mines were a property of the monarch, and the precious metals were presented as offerings in their temples and also used by the nobility. It seems probable that copper gold was extracted from the "native ores," but there are reasons to believe that they were acquainted with the smelting process to extract silver from sulphides. When the Spaniards invaded the Inca empire they received as a ransom of the Inca Atahualpa $1,320,166 of gold, and besides this sum of gold, they obtained an unknown quantity of precious metals, by the pillage of the temples of the sun.

The Spaniards introduced work in the mines of the Indians and also the process of amalgamation, which was invented in Mexico.

The most important mines of Peru have been worked since that remote time. Such is the Cerro de Pasco, which from 1630 to 1891 has produced $750,000,000. The mines of mercury of Huancavelica, from its discovery to 1813, when the work was stopped, produced 1,040,469 *quintals*, or about 47,294 tons of mercury.

The abandonment of many of the mines has not been caused by their being exhausted, but for various other causes, such as revolts of the Indians, the war of the independence, and lately the war with Chile.

The ancients confined their work to the easiest and most accessible parts possible, without passing from the most superficial workings, and quickly giving up on encountering water or poor sections.

There is no doubt that with the aid of sufficient capital and modern machinery all these mines can be made to return greater riches than they ever did. The principal cause of the decadence of mining in Peru has been the lack of means of transportation, and, although there has been expended $150,000,000 on railroads which are the marvels of engineering, unfortunately they have not been finished, and have not produced the benefits expected from them. There are two railroads connecting the coast with the interior, the Puno Railroad, extending from the port of Mollendo, passing the city of Arequipa, to Puno, on the shore of Lake Titicaca, crossing the Andes at a height of 14,660 ft. It has a maximum grade of four per cent. and is 315 miles in length. There is under construction a branch from this road to Cuzco, about 200 miles, and when completed it will be the only railroad running parallel to the zones before named.

The Northern Railroad extends from Callao to Casapalca, 94·5 miles, and within two years will be completed to La Oroya, 41·5 miles. This road was projected to Cerro de Pasco. It crosses the Andes by the tunnel of Galera, which is 3,800 ft. in length and 15,645 ft. above the level of the sea. This road, although not finished, is of immense service, and a great part of the prosperity of the mines of Huanchiri and Yauli is due to it.

Besides these two roads, there was commenced a line from Chimboto to Huaraz, 172 miles, 50 miles of which was constructed, but a great part was destroyed in the war with Chile and by floods. This would be the most important railway in Peru, as it would open the richest silver mines in the country, those of the Callejon de Huaylas, in the Department of Ancachs.

The mining industry of Peru is not in a satisfactory condition, but there is every indication of improvement, and much more can be expected from it in the future. The miners have almost altogether confined themselves to the exportation of raw ores to Germany and England, which of necessity requires a very rich ore to pay the expensive freight charges. For instance, from the mining region of Callejon de Huaylas it costs about $260 to deliver a ton of ore at the reduction works in Germany.

The erection of reduction works in the mining centers would give a great impulse to the mining industry; this has been initiated at several places, and to-day are running many smelting works, lixiviation and amalgamation mills and ore dressing plants.

Foreign capital is finding its way to Peru, yet slowly, and lately companies have been formed in France, England, and in New York to work mines of gold and silver.

The mining laws of Peru are the old Spanish laws modified by different amendments by the government. A new mining code, which will give great facilities to the mining industry, is under consideration. According to the present laws, foreigners have the same rights and privileges as Peruvian citizens, as far as mining matters go.

The extent of mining claims varies as the character of the product varies. The unit of a claim for a mine in a metalliferous vein is called *pertenencia*, 168 meters in length, and from 84 to 168 meters in width, according to the dip of the vein, and is limited by vertical side planes. The *pertenencia* for coal and petroleum has 40,000 square meters, the smallest side of which shall not be less than 40 meters.

The pertenencias of gold placers have no fixed dimensions, but are determined according to the richness of the deposit and importance of the working capital of the mining companies.

The contribution on each pertenencia is $15 each six months, the payment of which is a sufficient guarantee for the possession of the mine. Besides this, there is an export duty, varying as to the character of the product and its value.

All machinery and mining materials are free of import duty.

J. BASADRE.

LA GUAIRA AND CARACAS RAILWAY.*

THIS railway runs from the port of La Guaira on the Caribbean Sea to Caracas, the capital of the republic of Venezuela, which is a city of about 75,000 inhabitants, situated at an altitude of 3,000 ft. above the sea level. The distance is only 22¾ miles, and in order to attain this elevation the line has had to be built with a ruling gradient of 1 in 26¼, rising to a height of 3,200 ft. shortly before reaching Caracas, and then falling 200 ft. to the terminus; the chief peculiarity of its construction is the extreme sharpness of the curves and counter curves, the generality of which have a radius of 250 ft., while one has as little as 140 ft. radius. The railway is indeed a wonderful feat of engineering, and the difficulties attending the working of the line are almost unique.

* Abstract of a paper by Edwin Harry Alfred Heinke, Assoc. M. Inst. C.E.

The line is single, with sidings for the passage of trains that meet. Its gauge is 3 ft., and the traffic, of which by far the largest portion is up-grade, is hauled by locomotives without any center rail. When the coffee crop is poor there is little or no traffic down to La Guaira, and many wagons go down empty. The track winds up the mountain side with yawning precipices on one side and towering heights on the other. In some places it runs through cuttings 70 ft. deep, alternating with short tunnels, of which there are eight, bored through the solid rock, the longest being about 120 yards in length; and the continual turning on the steep gradient, and on the edges of precipices, where there is sometimes a sheer drop of 1,200 ft., is alarming to passengers when first traveling by it. Mr. De Lesseps, after traveling upon it, remarked of the line that there was only one danger on it, but that was continuous for the whole distance from La Guaira to Caracas. It is, nevertheless, the fact that, notwithstanding the really dangerous character of the railway, there has not been a single accident to passengers during the eight years it has been in existence, and only one case of a breakaway on a goods train. This, however, is due to the unceasing vigilance of the employes, who know that they carry their lives in their hands, and also to the use of a very effective brake.

Owing to the sharpness of the curves, the driver often cannot see 20 yards in front of him, and men called "vigilantes" are stationed at intervals all along the track on the lookout for impediments, and for any threatening slip of earth, their duty being, in the event of danger, to report it at the nearest telegraph, the whole of the working arrangements, and of the meeting of up and down trains, being conducted through the telegraph offices. Excepting at the Caracas station, there are no signals on the railway.

The landslips are very frequent during the rainy season, which lasts about six months. As many as two hundred and two have been known to occur during one night, and this is a constant source of danger. Sometimes the trains have been imprisoned for three days between two huge landslips. On one occasion, the slips were so numerous, that on the whole tract there were not 400 consecutive yards of clear line remaining unincumbered, and the traffic was stopped for a fortnight. On another, two bridges were washed away, and a third much injured, and the traffic was interrupted for a week. Many of the cuttings were originally made with slopes which approached the perpendicular, although half of them are in loose earth, without any rock support. The present manager, Mr. Geo. Ross, is, however, making great improvements. The plan he has adopted is to cut away the outside wall of those cuttings which are near the edge of the mountain side, leaving the road on that side exposed. Then, when slips of earth occur from above, the rubbish is expeditiously removed by shoveling it over the edge of the precipice, instead of having to haul it out at one end or other of a deep cutting. This, at the same time, widens the track, and will facilitate the eventual addition of a second line of rails.

It has been found necessary, with the very sharp curves on this line, to give more super-elevation to the outer rail than ordinary practice warrants—in some cases, as much as 4½ in., and the author was surprised to see it recently stated (*Engineering*, Dec. 25, 1891, p. 753) that a committee of French engineers appointed by the Minister of Public Works, among other conclusions, had decided that super-elevation of the outer rail in curves, even for high speeds, was unnecessary, and in fact a cause of instability rather than otherwise.

The quantity of locusts that infest the line is so great that they frequently stop the trains. Even when only a few are crushed, the rails and wheels become so greasy that adhesion is destroyed, and slip occurs to such an extent that the trains often run back down the incline. Experiments have been made to clear the rails of them by means of a steam jet, and also by fixing brushes on to the cowcatcher; but owing to the sharpness of the curves, and the frequent reverse curves, neither plan has proved effective. The only remedy at present in use is sanding the line, placing a man for the purpose in front of the engine; but the platelayers have orders to do the same wherever the locusts are thickest, and also to brush them off the rails as much as possible. The nature of the line limits the number of vehicles that can be hauled to a very small number. The goods trains are composed of three wagons nominally loaded with 10 tons of freight, although usually carrying more; the average weight of the trains, including tare of wagons, but exclusive of engine, being 45 tons. On one occasion, however, with a new engine, a load of as much as 95 tons has been hauled from La Guaira to Caracas. The passenger trains consist, as a rule, of four coaches and a van, but even this number, especially when there are locusts on the line, occasions trouble on the sharp curves, the length of the train causing stress across the chord of the arc, or curve, which is trying to both the line and the rolling stock.

For fuel, patent blocks (Crown brand) are used, it having been found that Welsh coal destroyed the fire bars too quickly. These blocks cost at La Guaira £1 8s. per ton, and are admitted free of customs duty. Experiments several times repeated have shown their evaporative efficiency, with the locomotives used on this railway, to be equal to 8 lb. of water per pound of fuel; but the consumption varies much according to circumstances and to the skill of the drivers; the present general average is about 60 lb. per mile.

A variety of causes add to the working expenses of the line. The large quantity of sand which penetrates the machinery obliges the brasses and other parts to be refitted every three weeks and causes so much wear and tear of the tires that those of the bogies have to be renewed every six months. Leakage of the boiler tubes is continual and very troublesome. This the author attributes partly to the high pressure of from 145 lb. to 160 lb. on the square inch, and partly to the shocks which the engines sustain almost every minute as they pass from one curve to another; for, notwithstanding the slow speed at which the trains run on the average (two hours being allowed for the 22¾ miles), the passenger trains attain at times a speed of 18 miles an hour. The shocks shake down the fire brick arches, which rarely last more than a fortnight, so that a large stock is required for renewals.

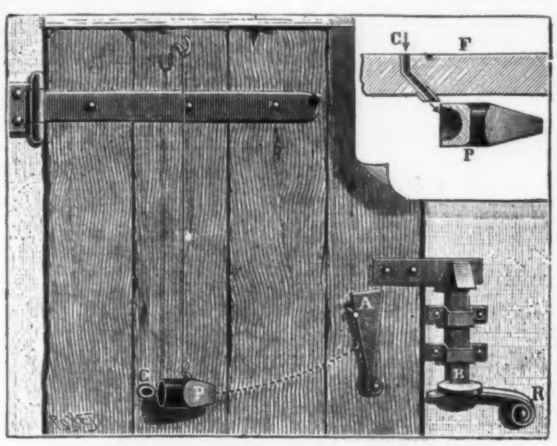
The engines are 18 in number, and are practically all

of the same type. That now adopted is the simple six wheel coupled outside cylinder tank engine, with a bogie at the trailing end, weighing, when in working order, from 34 to 35 tons. The tanks hold 600 gallons of water, and the coal bunkers 1 ton of coal, some of the blocks of patent fuel being packed in addition on the foot plate, and on the top of the tanks. The cylinders are 1 ft. 3½ in. in diameter, having 1 ft. 8 in. length of stroke; the wheels, 3 ft. in diameter, thus giving a tractive force of 133·5 lb. for each pound of effective pressure per square inch of piston. The engines are provided with a steam brake and with a hand screw brake. The coupled wheels are brought as close together as possible, the center ones being without flanges; the brake blocks are applied to all six wheels. The driving and center wheels are ⅜ in., and the trailing wheels 1 in. slack to gauge; the bogie has a lateral play of 3 in. on each side, the wheels being 1 ft. 10½ in. in diameter, and the tires 2½ in. thick by 5½ in. wide; those of the pony trucks are 2 ft. 7 in. in diameter.

The carriage and wagon stock consists of 21 coaches of first and second class, five vans fitted with postal, luggage and guards' compartments, and 110 wagons, which are of four classes, viz., covered, open, platform, and timber wagons, all of the bogie type. It speaks well for their workmanship and the attention bestowed upon them that, in spite of the severity of the line, a hot box rarely occurs. The first-class carriages are 24 ft. long by 7 ft. 6 in. wide; the second class (seating 25 passengers), 21 ft. long by 7 ft. 6 in. wide. The wheels, both of the carriages and of the wagons, are 2 ft. in diameter, and are interchangeable, which is a great convenience where renewals are so frequently required. All the carriages and wagons are supplied with a Heberlein brake, worked from the engine only, an extra man being placed on the foot plate for this purpose; the same man also attends to the sanding of the line when locusts are numerous. Most of the stock is also fitted with a hand brake, but this is rarely used, reliance being placed, as a rule, on the Heberlein friction brake.

ISAACHSEN'S SAFETY LOCK.

WHEN a body capable of vibrating or oscillating receives impulsions of the same period as those of its vibrations, its motion becomes amplified up to a certain limit. This principle, designated by the name of



ISAACHSEN'S SAFETY LOCK.

resonance, is one of the most important ones of physics. It is due to it that we see and hear. It is the basis of varied phenomena, and its applications are numerous. Bell ringers, causing a minimum force to act at a given moment, set in motion and ring the largest bells. The same principle has been applied by Mr. Cornu in the synchronization of clocks. It would take volumes to enumerate the most important applications of this principle. Let us mention, however, one very instructive experiment, due, we believe, to Mr. Helmholtz, and which constitutes a curious diversion. It requires nothing but a piano, and may therefore be classed in physics without apparatus. The *f* pedal, and the keys, *do*, *do*₂, *sol*₂, *do*₃, *mi*₃, and *sol*₃, that is to say, the harmonics of *do*₁, are depressed simultaneously; then any vowel whatever, say *a*, is sung on the tone of *do*, and the piano immediately responds; and so for the other vowels.

Let us pass to our lock, which was constructed by M. Isaachsen, a young Norwegian engineer. Wishing to close an isolated cottage situated in a forest near Christiansand, he devised the following arrangement:

Behind the door is suspended a pendulum, whose bob, P, is hollow on one side, and is beveled at the other. In a position of equilibrium, the hollow part is situated in front of the aperture of a curved channel, C, that debouches behind the door. If a person blows strongly into the aperture, C, the pendulum will begin to swing, but, whatever be the force of the breath, the amplitude will be very slight. If, at the moment the pendulum is passing through the position of equilibrium, after a complete oscillation, one blows again, the oscillation will become pronounced. After this maneuver has been repeated several times, there will finally be communicated to the pendulum an amplitude such that the bob will abut against a lever, A, so placed that a slight movement will bring it into unstable equilibrium, and it will fall upon a spring bolt, R, and the door will open. But if the duration of oscillation of the pendulum (which is absolutely unvisible) were unknown, one might keep on blowing for a week without reaching any result. There is therefore need of a key, which is nothing else than a string provided with two loops, one of which serves to hook it to a beam and the other for the attachment of a stone. We thus obtain a pendulum synchronous with the other, and the blowing is done at each of its passages through the vertical.

For relocking, it suffices to raise the lever, when the bolt, pushed by its spring, fastens the door. The lock constructed by Mr. Isaachsen was so arranged that with a little exercise the door was unlocked at the fourth oscillation. If, consequently, a person knowing the system, but not the period, wished to unlock the door, and was deceived by an eighth in the duration of the interior pendulum's oscillation, the fourth blowing would produce an effect exactly contrary to the first and the pendulum would stop. The two intermediate blowings would have produced no effect. For an error of a sixteenth, the fourth blowing would arrive at the moment at which the pendulum was at the end of its travel, and the effect would be null. The following blowings would diminish and annul the effect of the first ones.

It will be seen that the security is quite sufficient under such conditions, for fumbling, even though done systematically, would consume time. On increasing the weight of the pendulum, and consequently the number of blowings necessary for opening the door, we increase the security in a much greater measure, that of the square at least.—*La Nature.*

THE BROWN SEGMENTAL WIRE WOUND GUN.

AT the recent meeting of the American Institute of Mining Engineers a paper on the new Brown gun was read by Mr. N. B. Wittman, from which and from a published paper by Lieutenant G. N. Whistler, 5th U. S. Artillery, who is superintending the construction of the first gun on this system, the following has been compiled. The inventor, Mr. John H. Brown, is the inventor of the Brown military rifle. His "wire-wound" gun is to be given a thorough test by the United States government, and if it proves satisfactory, a large order will probably follow. This first and experimental gun is a 5 in. breech-loading rifle, high-power, 19 ft. long.

The system consists essentially of the subdivision of the inner tube of the gun, which takes up the initial compression, into longitudinal segments of such size that a higher physical condition and degree of special elasticity may be set up therein than it is possible to produce in the larger masses of metal used for the tubes of modern high power cannon. Layers of square steel wire—subjected to a constant tension of 180,000 lb. per square inch—are wound around these segments, binding them together, and a lining tube may or may not be used. The accompanying illustration shows a cross section of the gun. It was originally intended to have seventy-two segments, but for constructive reasons the number has been reduced to twelve.

The steel segments used in the gun now under construction are of crucible chrome steel, made by the Carpenter Steel Works, and are 18 ft. 4 in. long, 3 in. thick at the breech, and 0·8 in. thick at the muzzle. The wire has 0·005 square inch sectional area, and is wound upon the tube under a constant tension of 650 lb. on each strand, equivalent to 130,000 lb. per square inch. The physical condition of the steel segments and steel wire are as follows:

	Segments.	Wire.
Tensile strength........	165,000 lb. per sq. in.	250,000 lb. per sq. in.
Elastic limit	106,000 lb. per sq. in.	200,000 lb. per sq. in.
Elongation at rupture....	14 per cent. in 2 in.	..
Torsional strength.. ...		Thirty full turns in 8in. before breaking

The winding is done by a machine designed for the purpose by Mr. Brown. It consists essentially of a windlass and series of rollers, which act as a clutch, by which a weight is attached to the wire, and which is fitted with a friction brake, automatically regulating the speed of the passage of the wire through the machine. This speed being kept the same as that of the winding, the weight is thus held at a fixed height, insuring a constant and absolutely uniform tension upon the wire. Following the curve of maximum pressure, the segments are wound at the breech with thirty-three layers of wire, making a total thickness at that place of 2·31 in. of wire, and a layer is dropped at each 10 in., so that there are but ten layers at the muzzle, giving at that point a thickness of 0·71 in. Altogether, 3,256 lb. of wire were used, equivalent to a single strand extending in a straight line thirty-seven miles.

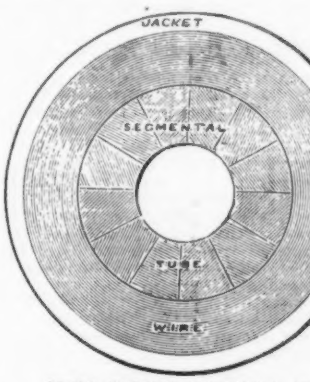
The wire was anchored at each end by a special device invented by Mr. Brown. As no flow of metal will occur below the elastic limit of the steel of which the segments are made, enlargement of the bore will not take place below a pressure of 94,000 lb. per square inch—this being 94 per cent. of the elastic limit, if that limit be taken at 100,000 lb. per square inch—the minimum obtained from any one of the test pieces. As the pressure between the segments at the surface of the bore, induced by winding, is 100,000 lb. per square inch, it will require a powder pressure of 63,200 lb. per square inch to reduce this compression to zero.

In order to demonstrate practically the truth of this proposition, a stub representing the powder chamber of the gun was made and incased in a steel jacket, into the ends of which heavy plugs were screwed, entirely closing the powder chamber, with the exception of an aperture, 0·28 in in. diameter, to serve as a gas vent and firing orifice. This has been fired repeatedly, with a charge which generated in all cases over 50,000 lb., often over 60,000 lb. and on four occasions over 66,000 lb. per square inch, and in every instance without the slightest indication of displacement of the segments or enlargement of the bore.

The trunnions are attached to a trunnion jacket, which is screwed to the breech of the gun. The major portion of the longitudinal thrust produced by firing is taken up by this jacket, and not by the inner tube. This is one of the special features of this system of construction. The chase of the gun—that is, that part in advance of the trunnions—is protected from the effect of small arms and machine gun fire by a steel jacket shrunk upon it. The breech block presents some novel features in the way of simplicity of design, and the maintenance of efficiency, in view of probable rough usage in actual service. A continuous thread is used, and when the block is thrown open for charging a latch locks it, so that it cannot be turned until it enters the breech. This insures a proper centering of threads under all circumstances, and a consequent minimum of wear.

The service charge of a gun of this size, made in the usual way, by shrinking steel hoops over a central tube, is limited to a powder pressure of 37,000 lb. per square inch; while in this gun the ordinary charge will generate 50,000 lb. pressure, and 60,000 lb. per square inch can, it is claimed, be reached with entire safety. The power required to penetrate modern armor is so great that a simple steel tube, no matter how thick, would not have sufficient elastic strength to resist the powder pressures which are essential in order to give the projectile a sufficient velocity to penetrate the armor of modern war ships. In order, therefore, to make guns of sufficient strength to resist modern powder pressures, the gun makers have been obliged to resort to a process by which the natural elastic strength of the steel tube is re-enforced by an outer jacket.

In the steel built-up gun this jacket consists of a series of hoops shrunk on to the core or body of the gun, while in wire guns this re-enforcing is produced by winding wire about the inner core under a high degree of tension. The shrinking on of the solid jacket, or the winding on of the wire jacket, produces a condition of initial compression, and the powder pressure must overcome this condition of initial compression be-



CROSS SECTION OF BROWN GUN

fore it will begin to stretch the inner tube. It is then manifest that the strength of a modern gun is a function of the elastic strength of the core of the gun plus the degree of the initial compression produced by the outer jacket. It is evident that the first action of the powder in overcoming the initial compression will be to stretch the outer jacket, and therefore this jacket must be made strong enough to resist the extreme pressures used in modern guns. It was to be expected that the enormous strength of steel wire would impress artillerists with its great value as a material for the construction of the outer jackets of high-powered guns, and Mr. Woodbridge might be properly called the "father of the wire-wound gun," if such men as Longridge had not already existed and worked in England.

A wire-wound cylinder can readily be constructed impossible to burst with gunpowder, but when an attempt was made to apply wire to this purpose, a difficulty of vital importance was encountered. The wire jacket itself had no longitudinal strength, and as the solid body of the gun had but about one-half of the longitudinal strength of a steel built-up gun of the same weight and caliber, the first wire guns broke in two longitudinally, under test, and all wire guns that have yet been tested have shown weakness in that direction. Various attempts have been made to overcome this difficulty. Longridge inserted thin longitudinal steel tapes between the layers of wire, in order to give longitudinal strength to the jacket itself. Dr. Woodbridge attempted unsuccessfully to produce the same result by bracing the wire together in a solid mass; and is now endeavoring to produce a gun in which he proposes to give sufficient longitudinal strength by placing segments about his solid core and then winding the wire. Mr. Brown proposes to solve the problem by doubling the elastic strength of the inner core itself. In order to produce that result, Mr. Brown conceived the idea of constructing a core of longitudinal segments, put together somewhat like barrel staves; in other words, he subdivides the body or core of his gun into such small pieces that he is enabled to obtain, by means of tempering, a degree of elastic strength that cannot be obtained in large masses of metal. It is a well-known fact that in pieces of steel which are small enough to insure tempering all the way through, it is possible to obtain very much higher physical conditions than can be obtained in large masses. We gather from all this that American steel makers have much to learn from Sheffield.

The following are the dimensions of the gun now under construction:

Length of gun	19 ft.
Length of bore, 44 calibers	220 in.
Caliber	5 in.
Weight of shot	60 lb.
Weight of powder charge	35 lb.
Weight of gun	3·5 tons.

The maximum pressure to be used in the gun will be 53,000 lb. per square inch. This will give a muzzle velocity of 2,500 ft. per second and a muzzle energy of 2,600 tons. The gun will thus be able to penetrate 13·54 in. of wrought iron at its muzzle.

As already mentioned, firing tests have been made with a cylinder representing the powder chamber of the gun, the dimensions of the cylinder being as follows, and the powder pressure, which would reduce the compression at the surface of the bore to zero, would be 63,654 lb. per square inch:

Length	16·00 in.
Diameter of bore	5·00 in.
Ext. diameter of segmental tube	11·00 in.
Ext. diameter of wire jacket	15·34 in.
Length of powder chamber	6·50 in.
Volume of powder chamber	127·63 cu. in.
Cross section of wire, square	0·071 in. × 0·071 in.
Tension of winding on wire	700 lb.
Tension of winding per sq. in.	140,000 lb.
Tensile strength of wire	1,250 lb.
Tensile strength of wire per sq. in.	250,000 lb.
Elastic limit of wire	1,000 lb.
Elastic limit of wire per sq. in.	200,000 lb.
Compression at surface of bore	100,000 lb. per sq. in.
Thickness of lining tube	0·50 in.

The following is from Lieut. Whistler's report on these tests. The cylinder was fitted with an obturating plug for each end, through one of which was drilled a small vent, $\frac{3}{16}$ in. diameter, the only escape for the powder gas being through this vent. In the first test cylinder, the plugs were screwed directly into the segments. Thus the segmental tube was submitted to an enormous and long-continued longitudinal stress, far greater than anything the segmental tube of the gun would ever be required to sustain. Furthermore, the segments were weakened by cutting the thread to receive these plugs. In the gun itself the breech block will be screwed into the breech nut, and no threads will be cut in the bore of the segmental tube, and the entire longitudinal thrust upon the breech block will be taken up by the trunnion jacket, and not at all by the segmental tube. Therefore in the gun the only longitudinal thrust which the segments will be required to sustain is that due to compression between the powder pressure and the wire pressure, plus that due to the friction of the shot in the bore. In order to assimilate as near as possible to the conditions of the gun, cylinder No. 2 was constructed as follows: The cylinder proper was inserted into an outer jacket, and the obturating plugs were screwed into this jacket, and not into the cylinder, the entire thrust upon the plugs being taken up by this jacket, and not by the segments. The only longitudinal thrust taken up by the segments was that due to radial compression of powder and wire, plus that due to the friction of the copper gas cocks, and was, therefore, about the same as the maximum thrust in the gun for the same pressures. This cylinder was fired seven times before inserting the lining tube and twelve times since. The lining tube, which is ½ in. thick at one end and 0·45 in. at the other, was constructed with four-tenths of 1 per cent. greater diameter than the bore, and forced in, thus producing a compression of the surface of the bore of 100,000 lb. per square inch, the chamber having been bored out to receive it. It is, therefore, manifest that in order to reduce the compression at the surface of the bore to zero a powder pressure of 63,654 lb. per square inch would be required.

Careful calibration showed the diameter of the chamber to be 5·002 in. before beginning the test, and the most careful calibration showed no variation in diameter of the bore.

The cylinder was then bored out and lined. Calibration gave the diameter of the chamber 5·000 in. After the first two discharges, the diameter was found to vary from 4·999 in. to 5·000 in., seeming to indicate that the liner had been shaken into position by these blows. From that time on to the end of the test no change could be observed. "The result of the above test is to demonstrate beyond question the strength of the Brown system of gun construction. No one witnessing test but would be satisfied that the cylinder would stand any reasonable number of discharges of 53,000 lb. per square inch pressure. And although but one shot has been fired at that pressure, I am confident that the same is true for pressures of 58,000 lb. per square inch."

Another point of interest is the action of the liner. The most careful examination could not detect the slightest displacement of the liner, except the setting into position, during the first two shots, under less than 28,000 lb. pressure. This was probably due to the method of insertion. There being no hydraulic ram convenient, the liner was driven in by blows.

ERNEST RENAN.

AT the last *Salon*, Mr. Leon Bonnat exhibited the portrait of the illustrious Renan, which we herewith reproduce for our readers. From the small house in Treguier wherein Renan was born, on the 27th of February, 1823, the route was long and difficult to the Pantheon, where it is a question of placing him. Treguier, a small place in Brittany, is an ancient episcopal town, one of the great monastic towns of mixed Gallic and Irish type founded by the Briton emigrants of the sixteenth century. With its deserted alleys formed by the high walls of the convents or the ancient canonical houses surrounded by gardens, it preserves to the present time the odor of devotion and seclusion.

The grandfather of Renan, a sailor of the country of Goelo, had, with his bark, secured a small fortune, which his son, a sailor also, risked unfortunately in trade. As he understood nothing of business, it resulted in July, 1828, in ruin and a fearful catastrophe. One day, his boat, returning from St. Malo, entered the port of Treguier without him. The mystery of his death was never explained.

After the father's death, the family was reduced to destitution. The eldest brother of Renan, then nineteen, started for Paris. The sister, Henrietta, would have embraced a religious life had she not had the little brother, to whom she devoted her life, and who she felt had need of her. Renan was then five. It was to supply the needs of him and her mother that the young girl undertook to give lessons in the neighboring towns. It was for him again that she made the still harder sacrifice of quitting her country and her people and losing herself in inhospitable Paris. For him she gave ear to a proposal to give private instruction in Poland.

Renan, whose education was begun at Treguier under some priests who directed a small seminary there, had awakened notice by his quickness. He was recommended to Abbot Dupanloup, who, desirous of securing a good pupil, offered him a scholarship in the seminary of St. Nicholas du Chardonnet. It was in 1845 that Renan left the Seminary of St. Sulpice at Issy, that had afterward received him, and where, thanks to the earnest and liberal spirit presiding at the direction of the establishment, he had pushed his philological studies very far. His religious opinions were very strongly shaken. His sister, Henrietta, was here again his support. She had forestalled him in the way; her Catholic beliefs had entirely disappeared, but she had ever guarded herself against exercising an influence over her brother on the subject. He communicated to her the doubts that tormented him and that made it a duty to him to quit a career in which absolute faith is demanded, and she offered to facilitate this difficult passage for him. He entered life at twenty-three, old in thought, but as inexperienced and ignorant of the world as it is possible to be. He was not then bachelor of letters. It was arranged that he should seek an occupation in Paris *au pair*, that is, receiving board and lodging, but training himself a sufficiency of time for his own work. Twelve hundred francs sent him by his sister were to permit him to wait and supplement what was insufficient at first in such a position. This money was the corner stone of his life.

Forced by reason of her health to abandon her position in Poland, Mlle. Renan in 1850 returned to Paris and settled with her brother in a small apartment near the Val-de-Grace, where she became for him an incomparable secretary and critic. She copied all his works and read in the proof all that he wrote, and to her he confesses himself to be infinitely indebted for his style.

Thus aided by his sister, he worked with such ardor that in three years he had mastered all the university grades. He made his debut at the Lyceum of Vendome, and in the following year Mr. Bersot resigned in his favor the chair of philosophy at Versailles. The Academy of Inscriptions during the same year decreed him the Volney prize for his first labors in linguistics. Moreover, it confided to him a mission to the Italian libraries. He returned with a study upon Averroes and Averroism that served him as a thesis for a doctor's degree.

The first step was taken, and after this he rapidly pursued his route toward the summit. At the age of thirty-three, he entered the Academy of Inscriptions and Belles-Lettres. In 1860, at the age of thirty seven, he preluded, by a mission to Syria, the series of his voyages to the East. Made chevalier of the Legion of Honor during the same year, he soon succeeded to the College of France, where in 1862 he took possession of the chair of Hebrew. His first lectures excited so much animosity among his adversaries, as well as among his admirers, that he had to give up his course. The government vainly offered him compensation, notably the position of sub-director of the National Library, but he declined all offers up to 1870, when his compatriot, Jules Simon, reinstated him at the College of France, where he recently died in his 70th year, surrounded by his devoted wife (a niece of the artist Ary Scheffer) and children.

ERNEST RENAN—FROM THE PAINTING BY BONNAT.

In his career as a savant and litterateur he produced some thirty-five different works, embracing pure science, moral speculations, philosophical dramas, narratives of travels, recollections, and studies upon Christianity. The best known of these after his celebrated Life of Jesus, are the History of the Origin of Christianity, the Antichrist, Caliban, the Priest of Nemi, the Abbotess of Jouarre, the Recollections of Youth, the Mission to Phenicia, and the History of the People of Israel, the last pages of which were but recently written.

The government gave him a public funeral, and the doors of the Pantheon are to be opened to receive him. Will this compensate for the irrealization of his last ambition? He had wished to sleep his final sleep in the center of the cloister of the cathedral of Treguier. "But the cloister is still the church," said he, "and the church does not want me."

WHILE sinking a mine shaft recently at Mysore the workmen broke into an old shaft, dug perhaps a thousand years or more ago, and in which were found implements of various kinds that bore unmistakable evidence of the former workmen being Chinese.

THE MANUFACTURE OF LIQUORS AND PRESERVES.*

By J. DE BREVANS, Chief Chemist of the Municipal Laboratory of Paris.

CHAPTER II. (*Continued.*)

MACERATION is applied to those substances which cannot stand a high temperature without being decomposed. This operation is performed by plunging the plants or flowers in a bath of old or fine fat, treated gently on a water bath. The fatty materials receive the essence and a perfumed oil or pomade is the result, and the essence can be extracted from this by means of alcohol. Paraffine is largely used at the present day. Rectangular frames with glass bottoms are used, the size being about 0·97 m. long by 0·64 m. wide. The fat is laid on the glass to a thickness of 0·0067 m., the flowers are thrown on this and they are allowed to remain from 12 to 72 hours, the flowers being changed as often as necessary. If the oil is used, the plates of glass are replaced by coarse linen saturated with oil. When the operation of absorbing the odor of the flowers by the oil is finished, the oil is obtained by pressure. To shorten this long operation M. Piver has invented the following apparatus. A square closet 2 × 3 meters in size is divided longitudinally into two parts, communicating with each other. Wire cloth screens receive the fat. Between each screen a thin sheet of glass or tinned copper is secured at one side only. This receives the flowers. The fat which is placed on the wire gauze is converted into thin, vermicelli-like threads. The flowers are placed upon the tinned copper plates and the closet is closed. Two pairs of bellows, one on each half, keep up a current of air. By this method the fat absorbs the perfume from the air with great rapidity, thereby obviating the danger of the fat becoming rancid. For several years past, the two methods of procedure just given have been displaced by a process which permits of relieving the plants of their odors in a very short time. The solvents are chloroform, sulphide of carbon, petroleum ethers, methyl chloride, etc. This invention is due to M. Millon and has since been perfected by MM. Piver and Naudin. The process comprises three operations: 1. The dissolving process; 2, distillation at a low temperature; 3, the evaporation of the last traces of the solvent. Fig. 34 represents the apparatus. The odorous parts of plants or flowers are introduced into a digester, A, being inclosed in a wire basket, E. A vacuum is obtained by means of a pump, D', and by means of this vacuum a known quantity of the solvent is brought up from R, by the tube *nn'*. After having placed the materials in contact with the solvent for a period not exceeding a quarter of an hour, the liquid is passed from A into B, by means of a vacuum. The water coming from the flowers is decanted by means of I. The tube, E', permits an easy separation of the various liquids. Communication is established between B and C, and also with the refrigerator or condenser, F. In the course of the distillation the temperature of evaporation is at that of the atmosphere, which is accomplished by a current of water. All the solvents are rapidly evaporated in C, and condensed in F, leaving the perfume in C. The solvent which was condensed is run into the receptacle, R. If the distillation has been made at a temperature sufficiently low, the liquid solvent will not retain any appreciable trace of the odor, and can be used again for different perfumes. The perfume mixed with the waxy substances of flowers and leaves must be dissolved by the preceding method. The wax is dissolved by ether. A quantity of alcohol contained in S is brought up by a vacuum. After a digestion of two hours, the liquid is thrown into the vessel, S, which precipitates the wax, while the perfume remains dissolved in the alcohol. The product is then filtered. In this process the liquid never comes into contact with the air.

Purification of Essences.—The raw essence cannot be employed without purification. Two cases come before the distiller, one in which the raw essences are dealt with and the other when they have become rancid. The first case is remedied in three ways:

1. The separation of essence by alcoholic vapors.
2. Congelation, which permits of separation by means of the different degrees of solidification.
3. Oxidation of essences by the use of the proper chemicals, as water, oxygen, permanganate of potassium, etc.

M. Duplais has indicated the proper manner of restoring essential oils when they have become rancid. The volatile rancid oil is placed in a still along with a large quantity of the recent plant and a sufficient quantity of water. The still is then started. The volatile oil is saturated anew with the perfume, and passes over with the fresh volatile oil from the plants. When a volatile oil is not entirely changed, but has commenced to lose color and limpidity, it is sufficient, in order to restore it, to pour it into a small glass retort placed in a sand bath on a furnace. The receiver is attached and distillation is proceeded with at a moderate heat, about equal to that of boiling water. The volatile oil which passes over is limpid and almost without color. The distillation is stopped when the drops begin to be colored. What remains in the retort is thick and has the appearance of a resin.

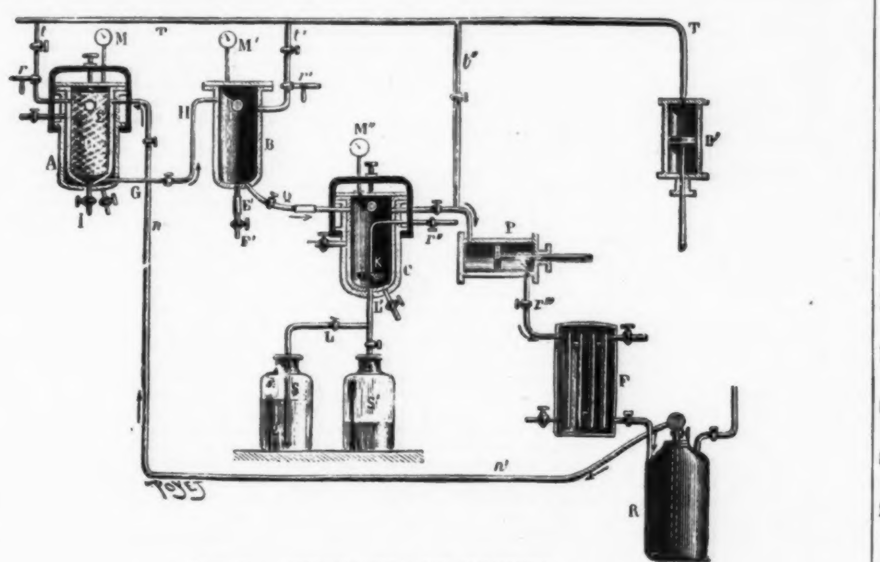


FIG. 34.—APPARATUS OF NAUDIN.

TABLE OF THE PRINCIPAL ESSENCES.

The following gives a synoptic view of the principal essences, according to M. Basset. The French names are also given, and the order of M. De Brevans is retained.

Essences Lighter than Water.

Absinthe (Large). *Grande Absinthe.*
The entire plant, used fresh, dark green, odor pronounced, grows darker with age.

Absinthe (Small). *Petite Absinthe.*
Entire plant, used fresh, lighter green, odor weaker than the *Grande Absinthe.*

Anise. *Aneth.*
Dry seeds, no color, pronounced odor of anise.

Anise (Green). *Anis vert.*
Dry seeds, no color, odor of the seed, crystallizes at +12° C., easily decomposed.

Angelica. *Angélique.*
Fresh plant, no color, odor of the plant, darkens with age.

Elecampane. *Aunée.*
Dry roots, yellow, odor of camphor, white when old.

Anise (Chinese). *Badiane.*
Dry seed, colorless; odor resembles that of anise a little; crystallizes at +15° C., turns yellow with age.

Basilic.
Entire plant, golden yellow, odor of the plant, darkens with age.

Bergamot. *Bergamote.*
Fresh skins, by distillation, colorless, odor of the fruit.

Birch. *Bouleau.*
Bark, colorless, very agreeable odor, resinifies when old.

Calamint. *Calament.*
Flower of the fresh plant, weak odor of mint.

Calamus.
Fresh roots, yellow, weak odor of camphor.

Camomile.
Fresh flowers, blue, little odor.

Cardamom (Large). *Grand Cardamome.*
Dry seed, light yellow, odor of musk.

Cardamom (Small). *Petit Cardamome.*
Dry seeds, light yellow, pronounced odor of musk.

Caraway. *Carvi.*
Dry seeds, light yellow, odor of the seed.

Cascarilla.
Dry bark, light yellow, odor of musk, bitter taste.

Cedrat. (Kind of Lemon.)
Fresh skins, by distillation, almost colorless, odor of the fruit.

Lemon. *Citron.*
Fresh skins, by distillation, almost colorless, odor of the fruit, becomes thick and resinifies with age.

Coriander. *Coriandre.*
Dry seed, yellowish, odor of the seed.

Cumin.
Dry seeds, yellowish, odor of the seed, sour, acid taste.

Curaçao.
Dried skin of Seville oranges, yellowish, odor of the fruit, taste bitter, thickens with age.

Fennel. *Fenouil.*
Dry seeds, clear yellow, odor of the seeds, cyrstallizes at +6° C.

Juniper. *Genievre.*
Fresh berries, colorless, trace of the odor of vanilla.

Ginger. *Gingembre.*
Dried root, yellowish green, odor of the root, burning taste.

Heliotrope.
Fresh flowers, weak odor of vanilla.

Hyssop.
Tops of flowers, yellowish, agreeable odor.

Lavender.
Tops of the fresh flowers, yellowish green, strong odor of the plant, darkens with age.

Marjoram. *Marjolaine.*
Fresh plants in flower, clear yellow, agreeable odor of camphor.

Melissa (Balm Mint). *Mélisse* or *Citronella.*
Flowering plant, almost colorless, odor of lemon, acrid taste.

Peppermint. *Menthe Poivrée.*
Tops of the flowering plants, colorless, odor of the plant, crystallizes between +21° and +22° C., turns yellow with age, taste fresh and sharp.

Nutmeg. *Muscade.*
Dried fruit, yellow; the essence has a slight odor of musk.

Orange Tree. *Oranges.*
Fresh flowers, yellow, odor of the flower, color changes to brownish red with time.

Oranges.
Fresh fruit, skins, by distillation or expression, light yellow, odor of the skin.

Rosewood. *Bois de Rhodes.*
Dry wood, yellow, odor of the rose, bitter taste, reddens and resinifies with age.

Rosemary. *Romarin.*
Fresh flowering plant, greenish yellow, odor of the plant, with a trace of camphor, burning taste.

Rose.
Fresh petals, almost colorless, agreeable odor of the rose, crystallizes below +10° C.

Sage. *Sauge.*
Fresh plant, yellow to green, odor of camphor and of the plant, turns dark with age.

Tansy. *Tanaisie.*
Fresh flowering plant, yellowish green, odor and taste of anise and fennel.

Thyme. *Serpolet.*
Fresh flowering plant, greenish yellow, odor of the plant, turns brown with age.

ESSENCES HEAVIER THAN WATER.

Bitter Almond. *Amandes Amères.*
Pressed oil cakes, pale yellow, odor of the kernel, changes with time, and oxidizes, poisonous.

Cinnamon (Ceylon). *Cannelle de Ceylan.*
Dried bark, yellow, odor of cinnamon.

Cinnamon (Chinese). *Cannelle de Chine.*
Dried bark, yellow, odor of cinnamon, less agreeable than the preceding.

Celery. *Celeri.*
Dried seeds, reddish brown, strong, sharp odor of the plant.

Clove. *Girofle.*
Dry fruit, yellow, pronounced odor of cloves, sharp taste.

Mace. *Macis.*
Golden yellow, odor of thyme, pepperish taste.

Nutmeg. *Muscade.*
Odor of nutmeg very pronounced when the essence is separated from the lighter portion.

Parsley. *Persil.*
Dry seeds, yellow to green, odor of the plant, bitter taste.

Saffron. *Safran.*
Yellow, odor of the plant, decomposes and resinifies with time.

Sassafras.
Dried root, reddish yellow, odor of the root, turns red with age.

Zedoary (Wild Ginger). *Zédoaire.*
Dried roots, pale yellow, odor of camphor, darkens in color with age.

As the result of many experiments, the following has been found to be product of essence for each 10 kilogrammes of materials used:

	Grammes.		Grammes.
Absinthe, large	12	to	12·5
Absinthe, small	4·5	"	5
Almonds, bitter	18	"	60
Angelica	28	"	—
Anise, green	118	"	200
Anise, Chinese	112	"	430
Camomile	8·4	"	40
Caraway	350	"	400
Cardamom, small	200	"	—
Cascarilla	62·5	"	87
Cinnamon, Ceylon	75	"	170
Cinnamon, China	22	"	75
Coriander	13	"	14
Fennel	21	"	23
Juniper	48	"	85
Laurel	32	"	80
Mace	12	"	60
Nutmeg, butter	350	"	360
Orange	5	"	30
Peppermint	70	"	—
Rose	0·4	"	1·6
Sassafras	6·4	"	50
Tansy	30	"	—

(*To be continued.*)

* Continued from page 14144, SUPPLEMENT No. 885.

WOOD PULP.

WOOD cellulose enters so largely into the composition of paper nowadays that any matter relating to its manufacture is of great importance to the paper maker. The treatment of wood by the now well known chemical methods for the purpose of preparing paper pulp from it is not very generally adopted by paper makers in this country, mainly on account of the prevalent notion that it can be purchased almost if not quite as cheaply as it can be made. Time and experience will doubtless tell whether any advantage is gained by making the pulp on the spot where it is used in accordance with the requirements of paper manufacturers, or whether it is better to follow the lines at present adopted in this country of purchasing the pulp from foreign producers. It is not our intention to discuss such a broad and deep subject as this is, in the limits of the present article, but to lay before our paper-making readers some facts relating to the manufacture of wood pulp which we commend to their careful consideration.

It is well known that wood yields a high percentage amount of pulp, and if it be compared weight for weight with other available fibrous plants, it will

probably be found to yield the highest of all. The development in recent times of many systems of treating fibrous plants has led to hesitation on the part of manufacturers as to the selection of any special system of treatment. Raw fibers of the type of esparto and straw can only be advantageously treated, so far as present experience goes, by one process, namely, the soda process. With wood, however, it is different, because we have three distinct methods of chemical treatment, known respectively as the caustic, sulphate, and bisulphite processes. These processes are employed on an enormous scale in Europe and America, and yield different quantities of paper pulp from the same kind of wood, as well as fibers differing from one another in quality and paper-making properties.

Although the yield of pulp from white pine in the soda or sulphate process is subject to fluctuation with the different conditions under which the wood is digested, yet, broadly speaking, there is a uniformity noticeable among the results obtained in factories where either of these processes is at work—the yield obtained in one factory using for example the caustic method being practically equal to the yield of another using the same process. Any apparent difference which arises in the comparison of results will be traced to differences in the mode of preparing and measuring the wood, and seldom to any great difference in the percentage yield of pulp from the actual weight of dry wood employed. As pulp wood is bought by measurement, instead of by weight, results expressed on the basis of the weight of wood used, unless so expressed very accurately, are uncertain, and will be found as a general rule to be of less value than those expressed on the measurement.

Some discussions have recently taken place on the comparative yield of pulp from pine wood (*Pinus silvestris*) by the different chemical processes in use on the Continent, and as these are more than usually interesting to paper makers at the present time in our own country we have the pleasure to reproduce them.

THE CAUSTIC SODA PROCESS.

In this process the purest commercial caustic soda is generally employed, the wood being digested at a pressure ranging from 110 lb. to 140 lb. per square inch above atmosphere in a caustic lye of from 14 to 17° Twaddell. The pulp obtained is bright in color, very soft, pliable and felts well. It is in every respect a good paper-making fiber, producing a soft pliable sheet admirably adapted to the requirements of the printer. The action of caustic soda on cellulose is, however, much more severe than any other chemical used in the pulp manufacture, and owing to this solvent action the fibers are rendered soft and pliable. Although paper makers endeavor to graduate the proportion of caustic to wood so that a comparatively high yield of pulp will be obtained, yet, as a matter of fact, experience has shown that it is impossible to obtain a pulp which will compete in bleaching properties with the sulphite pulps, and, at the same time, will compare favorably with the sulphite methods in point also of yield. Of the three above mentioned processes the caustic one yields the lowest quantity of pulp from unit measure of wood. It has been found by exhaustive trial that 124 kilos. of air-dry pulp can be obtained from 1 cubic meter of round logs. (Hennefeld.) 273 lb. of air-dry pulp are therefore obtained from 33·3 c. ft. of piled wood, or 1·171 cubic fathoms of wood are required to yield one ton of air-dry pulp containing 10 °/. of moisture.

In every wood pulp factory a certain proportion of the product ranks as second quality. The refuse from the wood preparing department, and the knots, etc., from the pulp strainers, etc., are included. It has been found that about 12 °/. of the above yield consists of second quality.

THE SULPHATE PROCESS.

Unlike the pure caustic lye, the liquors used in this process do not possess the same solvent power on the cellulose. The liquor is of a somewhat complex nature. Its composition varies, but it consists essentially of a mixture of caustic, sulphide and sulphate of soda, with small quantities of common salt and carbonate of soda. The wood is digested in a similar way as in the caustic method.

Speaking generally, the sulphate process is more difficult to realize and keep in perfect working order than the caustic one. The preparation of the "melt" or mixture of carbonate and sulphide of soda with an admixture of sulphate of soda is placed under the control of experienced workmen and carefully supervised by the chemist. If the soda "melt" is properly prepared, that is to say, if it contains the proper proportions of sulphide and carbonate of soda, the liquors obtained from it, after causticizing with lime, act on the incrusting materials of the wood almost as readily as pure caustic, and quite as effectually, producing a pulp which, compared with that from the caustic method, is longer, stronger, and usually brighter in appearence. Indeed, it is obvious that in respect to certain paper-making qualities this sulphate pulp lies midway between pure caustic pulp and the ordinary brands of first class sulphite pulp.

This process was introduced by Dahl in 1883, and worked on the Continent by him. One great objection to its use in this country is the abominable smell emitted from the charge of pulp and lye when the pressure in the boilers is blown off. Unless adequate means are adopted to prevent this odor from escaping into the atmosphere, the process, practically speaking, cannot be worked with advantage by manufacturers in this country.

The yield of pulp by this process from pine wood is greater than that from the caustic method. Hennefeld found that one cubic meter of piled logs gave on an average 145 kilos. of air-dry pulp of which 9 °/. was second quality. This result adapted to English practice gives a consumption of 1·147 cubic fathoms of pulp wood per ton of air-dry pulp made.

THE SULPHITE PROCESSES.

It is well known that the yield obtained by the different sulphite systems is the highest of all, but many conflicting statements have been made regarding it. Notwithstanding, many methods are at work in Europe and America, employing bisulphite of lime and magnesia, the percentage yield of pulp from wood has been proved by very careful experiment to be substantially uniform whatever process is employed. That is to say, a certain sort of wood will yield the same quantity of pulp whether it is prepared with bisulphite of lime or magnesia. These solutions have practically no solvent action on cellulose, and in virtue of this, the highest possible amount of fiber is obtained from unit weight of wood.

The difficulty in arriving at comparable figures probably lies in the direction of the nature of the wood itself, whether it is old or young, and also in the nature of the climate where it is grown. In addition to this, the fact that the wood requires more careful preparation for the sulphite processes, if a high class pulp is required, accounts, it may be, for a variation in the different statements regarding the yield. The extra cleaning and waste, together with the rejection in some case of certain parts of the timber, probably affects the returns. In high class pulp mills the wood is subjected to a most exhaustive system of selection and cleaning, the different qualities being worked up by themselves, yielding special brands of first, second, third, and even fourth quality pulp.

Figures recently published would seem to point out that, taking everything into consideration, the aggregate yield varies considerably in different mills. For example, at the cellulose factory of Weesenburgh, near Friberg, in Saxony, one cubic meter of piled logs yielded 140 kilos. of air-dry pulp, while at a South German work the yield obtained was 156 kilos. from the same quantity of pine wood. Other data from other works give the yield as being lower than the last named, and in some cases it is doubtless higher. The latter corresponds to the best practice, and adapting it to English figures, 1·067 cubic fathoms of pine wood are required to yield one ton of air-dry pulp. It should be noted that 20 °/. of this is equal to second quality and 6 °/. or so is third quality, fit only for the commonest of brown papers.—*Chem. Tr. Jour.*

PRATT INSTITUTE.

As is well known, Pratt Institute of Brooklyn was founded by the late Mr. Charles Pratt, a several-times millionaire of Brooklyn, N. Y., whose own early struggles for an education led him, in his later days of affluence, to consider some means of benefiting his less fortunate fellow-men. After months of study and careful investigation of the workings of other schools, the plan which was first developed in the free library and reading room broadened and deepened, until the present collection of buildings, numerous departments, broad courses of study, splendid mechanical equipment, and four thousand students, have become the well established representation of the founder's idea.

As an organization the Institute is governed by a board of trustees consisting of the three sons of the founder, and advised by the faculty, which consists of the directors of the six leading departments.

In the matter of equipment, Pratt Institute has great cause for congratulation. No school of its kind in the world can boast such a complete outfit of the best possible appliances. Imagine five large brick buildings, one six stories in height, 100 × 86 feet; a second of four stories, 144 × 95 feet; a third, an extension of the larger or main building, five stories high; a handsome three-story building 50 × 80; and a trade school building of one story, 103 × 95 feet. Steam heat, electric and gas light, a passenger elevator, a full equipment of the expensive machinery and other necessary accompaniments of a manual training school, have been supplied by a liberal hand. Extensive grounds for tennis, baseball, and other games are connected with the buildings, and it is estimated that over two million dollars have been spent in the furnishing and preparation of the entire property.

The principal departments are the technical high school, the art, domestic science, mechanic arts, kindergarten, commerce, music, and library departments. The technical high school alone, of all the departments, is giving full scope for regular, systematic application of the manual training theory in its fullest meaning, because in this department only are boys and girls received and taught by themselves through a course of years; while in all other departments those of mature years are admitted, and, to a certain extent, elect their own courses of study. Here a course in English branches, including history, rhetoric, algebra, geometry, botany, literature, trigonometry, physics, chemistry, and political economy, is combined with courses in drawing, wood and metal work for boys, and cooking, millinery, dressmaking, and wood carving for girls. No attempt is made to train carpenters, tinsmiths, or founders, cooks, milliners, or dressmakers, in a trade which may become a means of livelihood. The use of the manual training is understood to be purely educative of the mental faculties. True, the student may discover that he has an especial aptitude for some manual employment and may be led to adopt it, but such results are purely incidental and not in line with the main object of the course. The school day is divided into seven periods, three of which are devoted to recitations, one to study, one to drawing, and two to manual work. For example, in the first year of the course for boys, rhetoric, general history, algebra, plane geometry, physiology, and botany are studied by all the students, also freehand model and cast drawing and clay modeling, while the boys add to this bench working in wood, wood turning, and pattern making, and the girls plain sewing, hygiene and home nursing, and wood carving. Candidates for admission to this department are required to be fourteen years of age and usually graduates of a grammar school. A tuition fee is required in this, as in all departments, on the principle that an education which costs nothing is lightly valued, also in order to prevent a large influx of inferior material; but the charges are very moderate.

The department of industrial and fine arts is one of the most important and successful in the Institute, and nearly nine hundred pupils have registered in the day and evening classes during the past year. The courses included in the curriculum are: a regular art course, a normal art course, clay modeling, technical design, architectural drawing, mechanical drawing, wood carving, and art needlework. The entire fourth floor of the main building and several rooms on other floors are thoroughly fitted with the best possible appliances for art study, and each one of the fifteen studios is handsomely decorated with sketches, drawings, photographs, plates, and designs. Indeed, a careful observer might gain a not unimportant idea of the history and development of the various fine arts from the hundreds of photographs chronologically arranged in the halls, stairways, and rooms of the entire building. In whatever direction he turns there is always some object of artistic interest to please the eye. The practical application of art is everywhere studied, and as the study of form enters so largely into the theory of manual and industrial training, the pupils in nearly every department are, at one time or another in the course, to be found in the art rooms, and notable specimens of their handiwork are of especial interest to visitors.

The normal art course is constantly increasing in value, and the classes are correspondingly large. A glance at the work pursued here is certain to be of interest to students and teachers. In addition to the work of the first year in the regular art course, including sketching, lectures on perspective, composition, harmony of color, historic ornament and design, the work of the two years' normal course includes clay modeling from ornament and antique; water color painting from still life; elements of architectural and mechanical drawing; instrumental perspective; normal methods and teaching exercises; history of education and wood carving if desired. Opportunity for advanced work is also given. It is impossible to describe at length the complete scope of any division of this broad department. Lady visitors to the Institute are especially interested in the rooms where art needlework is taught in all its varieties, from the simplest tapestry stitches to bullion and ecclesiastical work, and magnificent specimens of embroideries from the Old World adorn the studios.

Doubtless the large, light kitchens, the long sewing and dressmaking rooms, and the dainty apartments where young milliners acquire proficiency in these womanly and necessary arts, attract the largest share of attention from the average visitor. The young cooks, in white caps and aprons, bending anxiously over the fragrant messes in preparation over the tiny gas cooker which is found at each girl's special table, make an interesting and picturesque scene. The variety of subjects considered in this department is practically unlimited. Soups and game, warmed-over dishes, salads and entrees, sauces and croquettes, a spring dinner, a white dinner, and cooking for invalids, are on the lists of subjects; and a course of study on the management of the Aladdin oven is promised for the coming season, also a study of the use of the chafing dish.

The nineteen hundred and more girls and young women who make up the roll of students in domestic science—one half of the entire enrollment of the Institute—have a large variety of subjects from which to choose a course. In the cooking school, as just noticed, there are a normal course of one year, two courses of three months each for which a special diploma is granted, besides the special course in invalids' cooking. Among the themes discussed by prominent lecturers before the normal course the past year have been: The Meat and Milk Supply of Cities; Food Production and Economy in the United States; Digestion and Physiology of Cookery; The Disposal of the Wastes of Modern Life; Personal Hygiene, the Care of the Body, and Public Hygiene, the care of the Body Politic.

An excellent course in household science, including the study of home sanitation, household economy and household art, should also be named in connection with the department of domestic art and science. In these, as in the classes in hygiene and home nursing and laundry work, evening classes at reduced rates are taught during a portion of the year, for the benefit of those whose daily employment prevents attendance in the day classes.

Close rivals of the cooking classes in popularity are the millinery and dressmaking classes. In the millinery department pupils must be at least eighteen years of age, able to do plain sewing neatly. In the first course, inferior material of artistic color is used while the pupil is being taught the best ways of wiring, binding, facing, making bows, and covering hats; and pretty and very tasteful combinations of colored canton flannels and sateens are displayed in the millinery parlor as the work of the first course.

In the second course lessons are given in silk and crepe bonnets and fancy turbans and toques, with lectures on color and outline to guide the pupil in selecting becoming head gear, while problems in designs and lessons in the most intricate studies of the milliner's art are taken up in the third course. A special class for those who wish to become practical milliners grants a diploma on the completion of a given line of work, including, the past year, the making of a large net hat, a lace edge bonnet, a large velvet hat, and a crepe toque. The best Paris models are furnished for study.

The courses in plain sewing and dressmaking are equally complete. A small army of sewing machines and dress forms are in constant use, but the most careful attention is given to the study of form, line and proportion, drawing of skirts and bows, general study of drapery, selection of fabrics, and practice in the use of color. A special course, for which a diploma is granted, is a feature of this department.

A survey of the department of mechanic arts shows a carefully graded system of instruction, beginning with bench work, the use of ordinary tools, wood turning, and pattern making; continuing with moulding, welding, making of steel tools, and tinsmithing; and concluding with machine tool work and construction. Students of the high school include this in a regular three years' course. Evening classes, constituting the trade school, for those who study to become carpenters, blacksmiths, bricklayers, plumbers, masons, stone cutters, or fresco or house painters, are under the supervision of this department, but the trade school proper is conducted in a building especially set apart for the purpose.

The wood working room of the technical high school is an especially interesting place for visitors, with its forty-eight benches, each provided with an outfit of ordinary hand tools; and of equal interest is the lathe room, where forty-eight 9" speed lathes, each with its full equipment of turning tools neatly arranged in cabinets, are presided over by as many boys. In this room are two jig saws, a band and a double circular saw, and a feed planer and jointer. The forge

shop and foundry are fully supplied with equipment for individual workers, and a great variety of specimens of the pupils' work in wood turning, pattern making, machine shop work, and forging are exhibited.

From the gallery surrounding the trade school rooms hundreds of visitors annually survey the busy winter evening workers at their tasks, and in all departments certain restrictive regulations are necessary to prevent the interruption of the thousands of visitors who are constantly seeking admission. It has been found necessary to limit the times for inspecting the building, and at present visiting days are Mondays, Wednesdays, and Fridays, from 10 A. M. to 12 M. and from 3 to 5 P. M. During the fall and winter terms, when the evening classes are in session, visitors are admitted from 7:30 to 9:30 P. M. of the same days.

Pratt Institute began its beneficent work with a small library of well selected books and a large free reading room. The library has grown to 34,000 volumes; and over 200 periodicals—the best published in the English, French, and German languages—are freely spread out for the use of the public in a large, well lighted, and well furnished reading room. 146,852 books were circulated last year to 17,000 subscribers, and sixteen assistant librarians are kept constantly busy. The special features of the Institute library are the large number of technical works relating to every branch of the various courses of study, and an extensive and accessible reference library, with qualified assistants to direct students seeking information in special branches. There are four thousand volumes of French and German classics, and a full supply of periodicals referred to in "Poole's Index." Authors and advanced students are given every possible advantage in the reference and library departments. For two years classes in training for library work, including instruction in typewriting, American and English literature, and English composition, have been carried on and largely attended. The literature classes are open to the general public.

The valuable department of commerce, which corresponds to a certain degree with a business college, has the perfect equipment and full corps of instructors found in all other departments. The course is not yet fully developed, but includes phonography, typewriting, English, Spanish, arithmetic, penmanship, and bookkeeping. Both day and evening instruction is given.

The kindergarten department is in its infancy, but looks to a complete course for the training of kindergarten teachers and the establishment of free kindergartens among the poor. The latter division of the work, however, is more properly in charge of the Brooklyn Kindergarten Association, which comprises citizens from all parts of the city and holds its meetings at the Institute.

A very excellent vocal music and vocal culture department is steadily gaining ground at the Institute. The tonic sol-fa system is generally taught, but abundant opportunity is afforded for the study of the staff notation. The Choral Society, which has for its especial aim the study of oratorios, has given several concerts, and is open to competent members of the various musical classes, holding weekly sessions from October to May.

A department of agriculture, giving a course of study in July and August, aims to give thorough instruction in theoretical and practical agriculture, and one hundred acres of farm land at Glen Cove, Long Island, have been set apart for its use.

"The Thrift" is an institution for the deposit and investment of small savings, and has three branches—the investment branch, the deposit branch, and the loan branch. Its affairs are conducted by an advisory council, and 630 subscribers are already interested in its workings. In the loan branch sums may be borrowed for the purchase of dwelling houses to be occupied by the persons making the loan, and payable in monthly installments not extending over fourteen years. Many homes have thus been purchased by investors, to whom, without the Thrift's friendly aid, such possession would have been impossible.

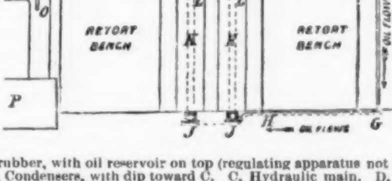
Of especial interest to students and visitors, and a most valuable addition to the Institute's equipment, is the technical museum, which occupies the entire fifth floor of the main building and is a mine of curious, beautiful, and interesting material. The collections may be classified, first, as inorganic substances—iron, gold, copper, silver, etc. Then large collections of ceramics, glass, building and decorative stones, illustrations of reproductive processes, organic compounds, such as wood, leather, and ivory and textile fabrics. The collections of glass, china, and elegant textile fabrics are of great interest and beauty, and hold the attention of all visitors. Very many of the rarest articles have been gleaned in European countries, and have intrinsic as well as technical value. Sightseeing in this great room is educative, and over thirty thousand people were enrolled among its visitors the past year.—*Christian Union.*

WILLIAM YOUNG'S NEW OIL GAS PLANT.

HITHERTO the process universally followed has been to carbonize the coal and oil in the same retort, and to subject the gases to the same treatment after leaving it. This Mr. Young has entirely set aside. He has been for years familiar with the process followed in the manufacture of gasoline, where the gas that is generated is purposely kept in the liquid which is sent out to be gasified. Borrowing a hint from this process, he vaporizes the oil, and, instead of retaining the illuminating gas which is part of the product, he releases it, and sends it on to the purifier—keeping back merely the portion of the oil which has not been converted into illuminating gas. It is there that the first point of his invention comes in. When oil is introduced into a retort, it is very quickly converted into vapor, only a small proportion of which, however—about one-fifth or one-sixth—is illuminating gas. The rest consists simply of vapors, which, on the opportunity arising, will once again resolve themselves into oil. That which has been really gasified will remain so like any other gas; but then the question arises: What will resolve the ungasified vapors? Mr. Young has been able to supply the answer; and it is simply this: Oil itself. Working on these two radical principles, he has succeeded, where all others have failed, in carbonizing the whole of the oil. Where others, working with a high heat, found that they had trouble with the inlet or the ascension pipes choking, or, on the other hand, working with a low heat, that the gas was robbed, by condensation, of its illuminating properties and there was trouble from condensation, he had no difficulty whatever. In his hands, the whole of the gaseous products of the oil are extracted, but not at once; and those which, if passed on, would condense, are sent back to be again subjected to treatment in the retort. In Mr. Young's view, oil is a hydrocarbon, and contains nothing but gaseous products and carbon. There is practically no tar, nor any condensable or non-gasifying liquids in it. The mistake hitherto made has been in attempting to gasify oil at one operation. When a quantity is placed in a retort, it is found to vaporize very quickly and pass on; but time has not been given; and it cannot be taken, in the retort, for the complete gasification of the whole of it. Consequently, the portion which has been merely vaporized, but not gasified, will sooner or later return to a liquid state. By Mr. Young's process, the earliest opportunity is taken for converting these vapors again into oil, and sending it back to the retorts for further treatment. Working in this way, he obtains practically only two products—a permanent gas of nearly 100 candle power and a very rich coke. The only other product is a very small percentage of sulphureted hydrogen, which is eliminated by the purifiers.

In describing the process, it may be said that it is simplicity itself. No materials are required except the oil, with the addition of the heat of the oven; and no mechanical appliances are used, not even an exhauster. The starting point of the process, for purposes of description, is the scrubber. This is an apparatus entirely similar to that which Mr. Young has introduced for the treatment of coal gas. It is of the familiar upright cylindrical shape, of cast iron, and is built in sections. Each section has a diaphragm, or shelf, in which are a number of papilliform openings, pointing upward. Each opening is covered by a tin cap, from the center of which a wire passes downward to keep it in position. On each diaphragm there is, in the oil process, a supply of oil, regulated so that the tin caps dip into it to the extent of one-eighth of their depth. From the scrubber there proceeds, at considerable length, a condensing pipe, in serpentine form, placed horizontally, but with a dip falling away from the scrubber. On the top of the scrubber is the oil supply reservoir with graduated scale and regulated outflow. By an ingenious arrangement, the outflow is so managed that, according to the prevailing temperature, it can be directed into either of the divisions of the scrubber. The scrubber in use at Peebles contains four diaphragms. In time of severe frost, the fresh supply of oil can be sent into the scrubber above the top diaphragm, and so be caused to pass down through the other three. In milder weather, the fresh oil can be introduced at will into the space above the third, the second, or the first diaphragm. Recently, when our representative had an opportunity of seeing the apparatus at work, the temperature was such that the oil was not passed into the scrubber at all, but was sent direct from the reservoir on the top into the end of the condenser next the scrubber; due provision being made for the renovation of the oil in the scrubber. As stated above, the condenser has a dip away from the scrubber; and when once the oil is in the condenser, it travels, against the flow of the gas, into the hydraulic main. From the latter (provision being made for sealing), the oil is carried forward to a reservoir where it is stored till it is required to be sent into the retorts. From this reservoir, again, a pipe leads into the retort house, where there is placed a regulating apparatus, by which the man in charge is enabled to control the whole of the process. The retorts are used for oil only. With ordinary oil they run twenty-four hours without being opened; but should the oil deposit carbon in such quantities as to necessitate it, they would, of course, be opened more frequently. The oil is led from the regulating apparatus, through a properly sealed pipe, into the ascension pipe, about half way up the face of the retort. Entering there, and flowing down the ascension pipe, it helps to keep the passage open. In addition, the retorts are maintained at a low temperature—a dull red heat; and the two influences combined prevent any tendency to choke. As a matter of fact, when the retort lid is taken off at the end of twenty-four hours, all that is found is a stalactite-like formation of carbon at the mouth of the ascension pipe, with an opening, however, in the center of it, which is sufficient for the entrance of the oil and the exit of the gases. Such a thing as a choked pipe has never been known with this process. The retorts dip to the back, for reasons which will be explained later on. The oil, having been introduced into them, is, as stated above, vaporized; and the whole of the vapors pass up the ascension pipe and into the hydraulic main. This is sealed with oil, derived from the condensers; and the condensable vapors are there arrested to some extent. Passing onward, the gases enter the condenser, down which, as already explained, the fresh oil flows; and there a further portion of the condensable vapors are resolved again into oil, and flow back into the hydraulic. Should the gases pass the condenser, they have still to encounter the scrubber, through the four diaphragms of which they have to bubble; and the result found in practice is that, by the time the uppermost diaphragm is passed, all that remains of the vapors which left the retort is a permanent gas, possessing exactly the same properties, except as regards its specific gravity, as that derived from coal. Having passed through the scrubber, this gas is led into the main which comes from the coal gas condensers, and, mingling with it, flows into the purifiers. So far as the oil gas process is concerned, the operation there comes to an end. The difference in the specific gravities of the two gases is found to be no bar to their combination. For all practical purposes, when the two gases enter the purifiers, they are one; and after they leave the purifiers, no difficulty is experienced with respect to their intermingling. Neither is there any deposit in the pipes—that being out of the question, seeing that all that leaves the scrubber is simply illuminating gas and a little sulphureted hydrogen. To return, however, to the process. It has to be noted that the vapors, on leaving the retorts, consist of only from one-fifth to one-sixth of permanent gas, and that the remainder are again converted into oil, and sent back to the retorts. Consequently, the latter, dealing with this five-sixths, or thereabout, of "old oil," cannot take a full quantity of fresh oil; and the supply of fresh oil from the reservoir on the top of the scrubber must be only one-fifth or one-sixth that which is passing through the retorts. This is one of the most ingenious parts of the process—the maintenance of two different degrees of flow; but the apparatus is so arranged that, in practice, there is no clashing of the two "interests." If the inflow of fresh oil is too slow, all that happens is that the store in the reservoir serving the retorts falls; and an indicator gives warning in time to enable the supply to be augmented. In the same way, if the quantity is more than the apparatus can deal with, the only result is that the oil in the retort supplying reservoir rises, and the attendant has simply to restrict the supply of fresh oil. The process is so flexible that, if it is required to produce more oil gas, the attendant has simply to fire up, and augment the supply of fresh oil; or if less should be needed, he merely has either to cool down, or throw the retorts out of use for an hour or two.

In making the oil gas, the process is continuous, and does not require any attention, except in regard to the heat and the inflow of oil; and the latter only requires looking after once in every two or three hours. The retorts at Peebles—both those employed in the manufacture of coal gas and those which have been adapted to oil gas making—are fired on a semi-regenerative system, which Mr. Young has devised. The method of firing has, however, nothing to do with the efficiency of the oil process. For the working of this, a setting of three retorts has been withdrawn from the work of producing coal gas, and the oven has been fitted up with two retorts suitable for carbonizing oil. The method of working consists in simply closing the retorts and turning on the oil; then, at the end of say 23 hours, the oil supply is cut off, and the retorts are allowed to stand for an hour, in order that the last run oil may have time to vaporize, and the coke to solidify. When a retort is opened, all that is found is a few carbon stalactites at the mouth of the ascension pipe, and a thin layer of coke in the bottom of the retort. This is easily raked out; and the bottom is then scurfed—an operation which is easily performed. The retort is now ready for another turn. While Mr. Young is superintending the process, it should be stated that Mr. A. Bell, Jr., the manager of the works, has charge of the whole of the operations, and that he is keeping a record of the quantity of oil consumed in every charge, and of the resultant gas and coke.



A, Scrubber, with oil reservoir on top (regulating apparatus not shown). B, Condensers, with dip toward C. C, Hydraulic main. D, Outflow oil pipe from hydraulic main, carrying five or six times the quantity of oil drawn from the reservoir at A. E, Oil reservoir from which the retorts are supplied. F and H, Supply pipe to retorts, doubled after passing G. G, Regulatimg apparatus for flow of oil into the retorts. J, Mouthpieces and ascension pipes. K, Ascension pipes running along the top of retort bench to hydraulic main. L, Retorts, with dip to back. M, Pipe conveying oil gas from scrubbers to purifiers. N, Pipe conveying coal gas from condenser. O, Point where oil and coal gas intermingle. P, Purifiers.

We will now give a more technical description of the process; the plant for carrying it out being shown in the above diagram, which is drawn from recollection, and is not according to scale. It is simply intended to give a better idea of the working of the process than the letter press probably conveys. If it had been intended to furnish a correct representation of the plant, the purifier would have been shown as far away from the retort bench as nearly half the width of a column of this journal. The consideration of space is the only reason for N, O, and P being brought so close to the retort bench as represented. The plan may be said to consist in decomposing the oil by repeated alternate exposures to a dull red heat in the cast-iron retorts and condensing and washing with oil; the result being the entire splitting up of the oil into gaseous products and solid carbon. The plant employed is very similar to that used to carbonize coal for the production of gas—consisting of retorts, hydraulic mains, condensers, and scrubber washer. The retorts are of cast iron, 2 ft. in diameter and 9 ft. long, and circular in form. Two are placed in a setting, with a considerable fall to the back. Each retort is provided with a stand pipe 5 in. in diameter. The condensers and scrubber washer are arranged to allow of the liquid products falling back into the hydraulic main, from which they are drawn off into a covered cistern provided with a float and indicator. From this cistern they are allowed to flow in regulated streams into the stand pipes of the retorts. The supply of oil to be decomposed is obtained from a cistern placed on the top of the scrubber washer. By suitable arrangement of pipes and valves, the oil can be admitted to flow down through the whole or any number of the compartments of the scrubber washer, or it may pass direct to the hydraulic main, according to the amount of washing and decomposing to which it is desired to subject the gaseous products.

The oil is admitted to the plant by a graduated valve, flows backward through the apparatus, and collects in the covered cistern at the end of the hydraulic main. When there is a sufficient supply of oil in the cistern, it is admitted, by means of suitable valves and siphon pipes, into the retorts, as already stated, through the stand pipes. When passed into the retorts, which are heated to a dull red heat, the oil, flowing down the inclined plane on which they are set, is volatilized—the more volatile constituents first and the less volatile only after they have traveled well down to the far end of the retort. The different oils are thus subjected to varying amounts and periods of

heat, which leads to their partial decomposition in a gradual manner, according to their volatility. The partially decomposed oil vapors pass away up the stand pipes, where they are to a certain degree washed and condensed by the inflowing oil. The washing of the decomposed products is continued in the hydraulic main, condensers, and washer, by the oil flowing back to again undergo decomposition. The gaseous products of decomposition are thus rendered free from vapors which might be condensed; and they are thereafter passed through a meter, and commingle with the coal gas at the inlet to the purifiers. The quantity of oil fed from the supply cistern into the arrangement is regulated so as to be equivalent to that portion which undergoes decomposition in the retorts; and the exact quantity is indicated by the float in the cistern which receives the oil and condensed products from the hydraulic main—the float rising when the amount of oil supplied is in excess of that which is decomposed, and falling when it is less. The oil and the condensed partially decomposed products washed back with the oil through the hydraulic main to the feed cistern are regulated so as to flow into the stand pipes of the retorts in quantity a considerable number of times greater than that of those decomposed.

The higher the external temperature of the retort, the more rapidly are the oils and condensed products circulated through them in order to keep the internal temperature within the range suitable to crack up the oil, and so avoid producing an excessive deposit of solid carbon. The result of thus decomposing the oil is that it is completely cracked up into gaseous compounds and solid carbon; the latter being all washed back into the retort, where it forms a very pure, hard coke of great value. The coke does not at all adhere to the retort, but is easily raked out. There is no deposit whatever of carbonaceous matter on the top of the retort; and the stand pipes are left absolutely clean, the relative proportions of the coke and gas are dependent upon the character of the oil employed, and the temperature and rate at which it is circulated through the retorts in the process of decomposition. Any description of paraffin or petroleum oil, however crude, can be worked by this process; but what has been principally used at Peebles, and now wholly employed, is what is known as "blue oil," which is the portion of crude oil containing paraffin scale in solution, but which has been partially refined, and had its valuable scale removed.

The oil is of a dark blue opalescence, and of specific gravity ranging from 0·880 to 0·890. It can be very cheaply supplied in large quantities by the Scotch oil companies. From this class of oil, 21,000 or 22,000 cubic feet of gaseous products, and between 5 and 6 cwt. of pure coke, are obtained per ton. By decomposing the oil at higher temperatures, a much larger volume of gas is produced; but the quantity of solid coke left in the retort is increased very considerably, and the gross sperm value of the gaseous products is much reduced. Indeed, the object of the process, as worked at Peebles, is to produce an enriching agent as permanent as possible in character, irrespective of volume. The specific gravity of the gaseous products is very high—nearly that of air. A gallon of oil yields from 6¼ lb. to 6½ lb. of gaseous matter, which has a greater enriching value than a gallon of gasoline, and yields more light, when diffused through coal gas, than a gallon of paraffin or petroleum oil burned in the best form of lamp. Since the process of enriching coal gas with oil gas was commenced at Peebles, the coal used has cost 11s. 4d. per ton, delivered at the works; and it yields 9,500 cubic feet of 18 candle gas per ton. It requires 1,900 cubic feet of oil gas added to the 9,500 cubic feet of coal gas to bring up the illuminating power of the mixture to 30 candles. The present cost of the oil, delivered into the works, is 40s. per ton; and, as already stated, it produces from 21,000 to 22,000 cubic feet of gas of an enriching value equivalent to the product of at least 4 tons of first class cannel. The present cost for materials to produce 30 candle gas, calculated from the above data, is 15·66d. per 1,000 cubic feet. It is probable that, if the process should be generally adopted, as is likely, the price of oil will rise, with the increased demand, to perhaps 60s. or 65s. per ton. At that figure new life would be infused into the Scotch oil industry. American and Russian oils might prevent the price from going up any farther; but, taking oil at 65s. per ton, the cost of producing, by this process, gas of 30 candle power would only be 18·01d. per 1,000 cubic feet. The gas and oil industries would thus both be benefited.—*Journal of Gas Lighting.*

THE INTERNATIONAL CONGRESS OF EXPERIMENTAL PSYCHOLOGY, HELD IN LONDON, AUGUST, 1892.

By ARTHUR MACDONALD, Specialist in the U. S. Bureau of Education and Official Delegate to the Congress.

ONE of the distinguishing features of the late International Congress for Psychology is the prominent part that physiological investigations assumed. This may be taken as an indication of the prevalent tendency to study the objective rather than the subjective side of consciousness. Yet not a few of the members read papers which gave the results of an empirical study of subjective reality. The subject of hypnotism and allied states was also one of great interest to all.

Some of the most important questions considered were in the domain of the physiology of the brain, about which comparatively little is known. The statement has often been made that the frontal convolutions are the seat of the intellect as distinguished from the will and desire. This was based upon comparison in the development of this region in man and the lower animals, upon results of accident or disease in man and experiments upon monkeys by Ferrier, Horsley and Schafer, and upon dogs by Hitzig and Goltz. For the reason that antiseptic precautions were not taken in either Ferrier's earlier experiments or Goltz's or Hitzig's, it is not certain but that the results obtained may have been due to an extension of the effects of the injury. Professor Schafer thought it worth while to repeat these experiments upon the prefrontal region by a mode of operation that entirely avoided the shock following from a bilateral removal of a more or less extensive part of the brain. He said that he had often noticed in operating upon the brain that extensive bilateral lesions are liable to be followed by apathy and apparent idiocy, whether the operations were in the frontal or in other regions, more, in fact, in the temporal than in the frontal region. He thinks it is very probable, therefore, that (1) the question of shock and (2) that of considerable loss of brain substance and removal of support from the rest of the brain (thus impairing the cerebral functions generally) may modify the result. For these reasons Professor Schafer has recently operated, not by actually removing the portions of the brain, but by severing their connections with the rest of the mantle and with the brain stem. This can be effected with scarcely any hemorrhage and with no perceptible shock. In several instances in which Professor Schafer has thus severed the prefrontal lobes in monkeys, there was an entire want of appreciable symptoms. In no case did the animals show the dullness and apathy previously noticed, but they appeared as bright and intelligent after recovering from the effects of the anæsthetic as before the operation. These experiments, therefore, do not support the view that the prefrontal lobes are especially the seat of intelligent attention.

In this connection it will be interesting to note Professor Horsley's demonstration of localization of functions in the monkey's brain, which was given before a number of specialists and psycho-physicists. The monkey was put under the influence of an anæsthetic and quite a portion of the cranium removed. By electric stimulation Professor Horsley demonstrated clearly the fact of localization; he was able to predict before applying the electrodes what movements would take place, as in the arm, fingers and face. The experiment was very satisfactory to the witnesses, although Professor Horsley did not think it had succeeded as well as in many former cases when he had performed it before his classes.

These now well-known localized areas in the brain of monkeys have been found also by Horsley and Schafer in the anthropoid ape, which is still nearer man. But the proof has been made complete in a demonstration upon human beings by Professor Horsley. It was in the case of two epileptics in whom an operation was necessary. As far as the operation permitted, it was found that the same localization of function existed in man.

It is well to note that the success of experiments upon animals is often due to developed operative skill, as is obtained in surgery.

The writer has witnessed many operations of this nature by well-known specialists, but has never seen it so neatly done as by Professor Horsley. Professor Horsley was also very careful to see that the animal felt no pain throughout the whole operation. One is reminded of Professor Munk's experiments on the dog at Berlin, which attracted great attention at the time. Both Munk and Horsley are surgeons.

It is true that, if one single function is localized, brain localization is established; but this *a priori* method is being made less and less necessary by experimentation. It would seem from these and other investigations that the intellectual function is diffused over the whole brain; this is strengthened by purely psychological considerations from the directing power of the reasoning faculty over the psychical functions in general.

It would seem probable that by more exact methods and skillful operations general localized areas will be established throughout the brain, but that these areas can be absolutely defined is quite improbable; first, because they seem gradually to overreach, one area into the other, and, second, the brain is a vicarious organ and the extent of this characteristic will be difficult to determine. But when one thinks of the complexity of the finer anatomy of the brain, not to mention its histo-physiology and chemism, the vastness of the field of investigation is evident: yet these positive results in the coarser anatomy and physiology are an initial starting point of the highest importance, and may lead in the future to things as yet unthought of.

A recent experiment illustrating kinæsthesis was described by Dr. Ransom; it was a case of epilepsy where the convulsions began by tingling and spasm in the left hand; the following permanent abnormal conditions resulted in this hand: (1) Slight tactile anæsthesia, (2) diminution of muscular sense, (3) diminution of motor power.

The operation showed a cyst compressing the cortical center for the left hand. After recovery from the operation this area was faradized by electrodes inserted through the scalp, without an anæsthetic. From this resulted (1) contraction of groups of muscles in arm and hand by moderate current, (2) production of sensation with a weaker current, contraction added when current was strengthened, (3) improvement of muscular sense during and after stimulation, (4) weakening of voluntary motor power, after a strongly induced contraction.

Dr. H. Donaldson, in his observations on the anatomy of the brain of Laura Bridgman, found the following peculiarities: Depression of the motor speech center, a slenderness of the first temporal gyrus on both sides and a blunting of both occipital poles with a special disturbance of the fissures in the right cuneus, poor development of temporal lobes, the cranial nerves connected with the defective sense organs were slender, the left optic nerve being the one most affected; the extent of cortex was normal, but unduly thin all over;. this thinness, however, was most marked in the areas for the defective senses, due in part at least to the smallness of the cortical cells there present. In general, the case represents a maximum peripheral disturbance in the sensory cranial nerves, associated with only such central lesions as followed from lack of exercise and growth.

In his investigations of the muscular sense in the blind, Dr. Goldscheider found a developed sense of touch in the hand and finger joints, and the cause of this was psychical, consisting in a sharpening of the attention and in practice. The sense of location in the skin is small in the blind.

In order to recognize forms by touch, the sensation of motion is of greater importance than the sensibility of the skin. Children, whether blind or not, possess a finer sensibility for passive motion than adults.

An interesting paper was that on "A Law of Perception," by Professor Lange, of Odessa. The process of every perception consists in a rapid change of a whole series of psychical moments or steps, in which every preceding step presents a less concrete and more general condition, and every following step a more concrete and differentiated psychical condition. There are four principal steps, or stages, in this process of perception: (1) the simple shock, without quality, (2) the consciousness of general modality in the sensibility, (3) consciousness of its specific quality, and (4) consciousness of its spacial form.

The steps, or stages, of our perception correspond to the development of perception in general biological evolution. The so-called muscular reaction consists in a reaction in consciousness upon a simple and undifferentiated shock; the muscular or the innervation effort is not essential to the muscular reaction. The so-called sensorial reaction is not a determinate act, but the reaction called upon one of the following steps of perception, The relation between subject and predicate in an act of judgment is a particular case of the law of perception. The consciousness of difference has no ground in the sense of time. The so-called time of choosing shows no element of will.

Mrs. C. L. Franklin, after explaining the difficulties of the Hering or the Young-Helmholtz theories of light sensations, proposed the following new theory: In its earliest stage of development vision consisted of nothing but a sensation of gray (using the word gray to cover the whole series, black—gray—white). This sensation of gray was brought about by the action upon the nerve ends of a certain chemical substance, set free in the retina under the influence of light. In the development of the visual sense, the molecule to be decomposed became so differentiated as to lose only a part of its exciting substance at once; these chemical constituents of the exciter of the gray sensation can therefore be present separately and cause the sensation of red, green, and blue. A recombination of these substances produces the gray sensation; the mixing of these three colors gives a sensation of no color at all, but only gray. The theory is that of a differentiated color molecule.

Professor Pierre Janet gave a somewhat extensive description of a disease which he designates as a new form of psychological disaggregation, a mental disease consisting in the weakening of the power of synthesis, which permits during each moment to attach new psychological phenomena to the personality which are reproduced in the mind. This disease has different forms, according as the incapacity for synthesis affects the sensations, movements, or souvenirs.

Professor Liegeois, of Nancy, showed it to be quite probable that a woman, who had been condemned to twenty years of hard labor for attempting to poison her husband, was suggestible and hypnotizable to a high degree; that she had received suggestions from a doctor, her lover, to poison her husband in order to be able to marry the doctor; that her moral liberty was greatly diminished, if not abolished. Professor Liegeois commended such cases to magistrates, judges, physicians, and juries, so that incompetence and contradictions and excessive severity may be prevented.

Dr. Liebeault and Professor Liegeois described a case of monomaniacal suicide, which was cured by suggestion during hypnotic sleep. It was a woman who had had tendencies to suicide for eleven months.

Dr. Berillon, editor of the *Revue de l'Hypnotisme*, spoke on the applications of hypnotic suggestion to education. From an experience of attempting hypnotism with some 250 children of both sexes, he deduced these conclusions: In ten children from six to fifteen, of different classes of society, eight could be put into profound sleep after the first or second seance. Contrary to the general opinion, the difficulties of causing profound sleep were greater in proportion as the child presented neuropathic hereditary defects. Healthy children with good antecedents were generally very suggestible, and consequently hypnotizable; they are very sensitive to imitation. While their sleep has the appearance of normal sleep, yet it is easy to obtain amnesia on awaking, negative hallucinations, suggested dreams, and automatic accomplishment of suggested acts. This sensibility to suggestion and hypnotism has been utilized in treating cases which concern pedagogics as much as medicine; such are those with nervous insomnia, nocturnal terrors, somnambulism, kleptomania, onanism, incontinence of urine, inveterate laziness, filthiness, and moral perversity. These facts have been verified by a large number of authors; they belong to practical psychology. Suggestion constitutes a process of investigation which permits us to submit to a rigorous analysis the different intellectual faculties of children, and thus to aid pedagogics by the experimental method.

Mr. F. W. H. Myers, in a paper on "The Experimental Induction of Hallucinations," considers it a drawback to experimental as compared with introspective psychology that we are liable to lose in profoundity what we gain in precision; new experiments are required if the operations of the subconscious strata of our intelligence are to be reached; such operations tend to be manifested spontaneously in forms of active and passive automatism, such as automatic writing and visual or auditory hallucinations. As to the extent to which these phenomena can be reproduced experimentally, hypnotism is at present the principal means. A form of hallucination which is harmless and easily controlled is "crystal vision," that is, the induction of hallucinatory images by looking steadily into a crystal or other clear depth or at a polished surface. In this way the crystal helps the externalization of those images, sometimes by scattered reflections which suggest *points de repère*; or by partially hypnotizing the gazer. But a crystal vision may sometimes pass insensibly into the summoning up of externalized images, or quasi-percepts, with no definite nidus or background. Such images, or percepts, may depend upon a perceptivity antecedent to sensory specialization and of wider scope.

In speaking of experiments in thought-transference, Mrs. Sidgwick considered the hypnotic state as favorable in such inquiries. By thought transference is meant the communication of ideas from one person whom we call the agent to another called the percipient, independent of the recognized channels of sense. Mrs. Sidgwick conducted her experiments in conjunction with Prof. Sidgwick and others. The successful percipients were seven in number, and were generally hypnotized. It was possible to transfer numbers

mental pictures—that is, mental pictures in the agent's mind—and induced hallucinations given by verbal suggestion to one hypnotic subject and transferred by him to another.

There were failures, but the proportion of successes was sufficient to show that the result was not due to chance. One percipient succeeded in experiments with numbers, when separated from the agent by a closed door and at a distance of about seventeen feet. Sometimes the ideas reached the percipient as visual impressions received with closed eyes, sometimes as hallucinations on a card or paper, or by automatic writing, or by table tilting.

It is not known how to produce results at will; only certain persons seem capable of acting as agents or percipients, and these persons succeed at one time and fail another, varying at different times in the same day; the reason for this is as yet unknown.

In the nerve centers of flying in certain insects, Alfred Binet showed that the dorsal root is motor and the ventral root is sensitive.

Professor Preyer, of Berlin, read a paper on the origin of number. All concepts can arise through the senses only. No concept (even the concept of number) through heredity alone, without individual sense impressions, can take place. But the child, like many animals, can value things and numbers without knowledge of numbers; it feels the numbers, not by means of touch or sight, but through hearing. The series of positive whole numbers did not arise originally through addition of 1 to 1; such a hypothesis presupposes a knowledge of a number, namely, of 2, and a method of adding. Numbers are acquired in a normal way through hearing and comparison of tones, but later through touch and sight.

As to the effect of natural selection on the development of music, Dr. Wallaschek said that primitive music is not an abstract art, but, taken in connection with dance and pantomime, is bound up with the necessities of primitive tribal life, that is, in war and hunting, for which these dances seem to prepare, and, further, that it helps the tribe to maintain its strength and skill during times of peace. These dances are of a social nature, being performed by the whole tribe with great exactness, due to the influence of rhythm, of which primitive music chiefly consists. This tie of music enables the community to act as one body, holding the community together. Tribes accustomed to *play* at war and hunting associate more easily, act better in case of need, and so are better prepared for life. The musical faculty is thus developed and trained for this purpose.

Dr. Witmer presented a contribution to experimental æsthetics, taking up "the æsthetical value of the mathematical proportions of simple figures." No measurements of the proportions of the human form, as found in nature or in art, nor in beautiful specimens of architecture, will demonstrate the æsthetic value of the mathematical relations of their parts; for we never can be sure that their æsthetic value does not rest upon an associative or other factor rather than upon the direct mathematical proportions; and the freedom in the choice of parts to be measured must throw considerable doubt upon the results of all measurements. Such attempts have proved no more than a limited æsthetic value of the proportion 1:1, while for the various other simple mathematical relations nothing decisive has been shown.

A better method than Zeising's or Fechner's affords a choice not limited to a set of arbitrary proportions, but opens to a series of figures whose mathematical proportions vary in a constant ratio between the proportion of 1:1 and 1:x (x being any desired large number). This method permits of an easy observation of the relative increase or decrease in the æsthetic feeling attaching to the regularly increasing proportions. For all groups of figures and for all positions of the figure there are but two pleasing proportions: the ratio 1:1, or perfect symmetry, and a ratio which lies between 2:3 and 1:2, the most pleasing proportion. The proportion 1:1 is æsthetically so far from all other proportions that a comparison between it and any other proportion on the same terms as between the other proportions among themselves is impossible. The most pleasing æsthetic proportion subsumes itself under æsthetic contrast; the æsthetic value does not lie in a pleasing and complex equality of the relations of the parts of a figure, but in a pleasing *difference* of parts. The proportion is therefore not clearly discoverable in complex designs and objects, as the demand for the best contrast of parts may easily give way to other considerations.

Dr. Alexander Bain's paper was entitled "The Respective Spheres and Mutual Helps of Introspection and Psycho-Physical Experiment in Psychology;" the recognized sources of our knowledge of mind are first and foremost *introspection* with the aids of outward signs; to which succeed the study of infancy, of abnormal and exceptional minds, and of the lower animals; also the workings of society collectively; next physiology; and last psycho-physical experiments. The metaphysical problem of knowing and being, and that of the tracing of the origins of our mental furniture, have hitherto been the leading ones where introspection has been mainly employed. Neither of these are utile in the ordinary sense. Introspection takes the lead in qualitative analysis of mental facts; the next consideration is quantitative analysis, or the mensuration of psychological quantities; here psychophysics can render important service. The following is a list of researches where both methods concur: (1) The economy of muscular mechanism; (2) the fundamental laws of the intellect, more especially as regards memory acquisitions; (3) the fluctuation of our ideas in consciousness; (4) the conditions of permanent association as against "cram:" (5) plurality of simultaneous impressions in all the senses; (6) the fixed idea; (7) similarity in diversity. In all these experiment can come in aid of introspection, but cannot supersede it without loss and failure.

Professor Theodore Ribot's paper concerning concepts had for its object an inquiry as to the immediate state of mind at the instant a concept is thought, to determine whether this state differs in individuals. One hundred persons of every class and degree of culture were interrogated by announcing to them abstract terms (not letting them know the purpose beforehand) and noting the immediate state of consciousness which these terms evoked. The results were: 1. With the majority a general term awakened a concrete idea or representation, ordinarily a visual image, rarely a muscular image. 2. Many saw the word as printed, purely and simply, without any concrete representation. 3. Others (fewer in number) had only the word in the mind as heard, perhaps with motor images of articulation but without concrete image; without vision of the printed word. 4. The highest concepts, such as cause, relation, infinite, etc., did not give rise to any representation whatever in the case of the majority. Even those persons belonging to the pure concrete type declared they had nothing in their minds.

There are therefore certain concepts to which an *unconscious* state corresponds. Hoping to penetrate into the nature of this unconscious state, Dr. Wizel continued the investigations on certain hysterical cases at Salpetriere; they were interrogated first in the hypnotic state, then when awake, thus permitting a comparison of responses. The results were more numerous and explicit in the hypnotic state than in the normal.

In speaking of the future of psychology, Richet said psychology is one of the elements of physiology, and the most obscure; the first question is to know the connection which unites mind and body; at present we know nothing about it. An idea, a reasoning, a passion, are phenomena which do not seem to have the power of being reduced to a material phenomenon. It is certain, however, that there is a connection: without brain, or rather without nerve cell, there is no intelligence. The first problem of psychology is therefore a most complete physiology of the brain: relations of ideation with cerebral circulation, with chemical changes in nerve cells, with electric phenomena; localization of psychical acts in this or that part of the brain; in other words, a physiological *resume* of the brain. We must recognize that brain physiology is little developed compared with the physiology of the heart or muscles. Physiology, properly speaking, is a study of sensations: relations of sensation with peripheral excitation, differential perceptive sensibility—the threshold of excitation; these are investigations more difficult to pursue than the general physiology of the nerve cell.

Comparative psychology treats of the relations of man with other beings, and with the insane and criminal, from the intellectual point of view. One cannot admit that the human soul is stationary; it evolves, and therefore can be perfected through a sort of natural selection. The data for this problem are wanting, yet the future of humanity depends upon it. In transcendental psychology we have numerous data (often or almost always imperfect), which permits us to suppose that human intelligence has extraordinary resources and forces of which we have no conception. The future psychology will give us the key to clairvoyance and presentiments. If it should be proved that these are all illusions, a service would be rendered; sooner or later we will be able to say whether transcendental psychology is a reality or an illusion.—*Science.*

A SEEDLING SUGAR CANE.

SEEDLING SUGAR CANES.

A SHORT time ago considerable interest was taken in the announcement made that seedlings of the sugar cane had been raised at Java and Barbados, and that, in spite of many statements to the contrary, the cultivated forms of the sugar cane had not entirely lost the power of producing fertile seed. Since that time, the seeds of the sugar cane have been observed in the glumes; they have, moreover, been fully described, and further, their germination has been so carefully observed as to leave no doubt whatever on the subject. Several hundreds of seedling canes raised at Barbados, Java, and latterly at Kew, have been grown during the last two years, and the variation among

them, as might easily be supposed, has been very considerable. Some few have already been proved to be of especial value. Of the vigor of growth of the new canes, it is sufficient to refer our readers to the illustration of a seedling cane grown at the Botanical Gardens, Georgetown, British Guiana. It yet remains to be proved whether the bulk of the seedling canes are richer to sugar and are better adapted to the requirements of the planter than the old canes. A somewhat careful and protracted system of experiment and selection will have to be carried out in order to eliminate the worthless sorts, and retain only those of special promise. Already we understand that in one remarkable instance a seedling cane grown at British Guiana from a batch of seedlings raised at Barbados has been pronounced to be superior to any of the existing canes. This is known as the Scaed cane. No doubt many other equally promising sorts will be forthcoming in the future. In the mean time we can only recommend those who have it in their power to improve so valuable and important a plant as the sugar cane to persevere along the well-known lines followed in regard to other economic plants. They must be satisfied with small advances at a time, and patiently wait for the success which must wait upon all intelligent and well directed effort.—*The Gardeners' Chronicle.*

A NEW PIPETTE AND NEW BURETTE FOR VOLUMETRIC ANALYSIS.

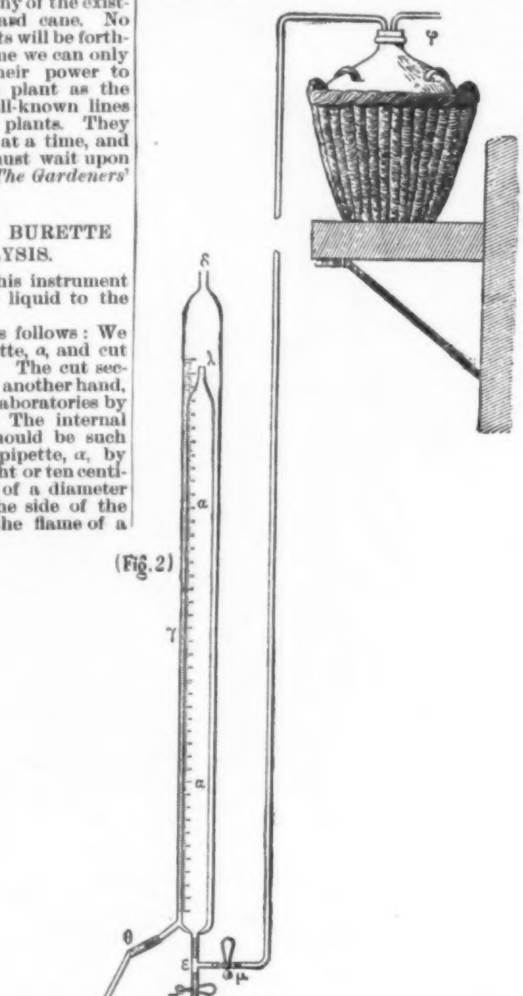
Industrial Pipette.—The novelty of this instrument resides in the automatic bringing of the liquid to the gauge mark by simple suction.

This pipette (Fig. 1) is constructed as follows: We take, on the one hand, an ordinary pipette, α, and cut it at the height of the gauge mark, λ. The cut section is smoothed on a grindstone. On an another hand, we select one of those tubes known in laboratories by the name of safety tubes with funnel. The internal diameter of the cylindrical funnel, γ, should be such that it may slide over the body of the pipette, α, by hard friction. The tube, β, is cut at eight or ten centimeters from the funnel. An air hole, δ, of a diameter of two or three millimeters, is made in the side of the funnel, γ, either with a diamond or the flame of a glass blower's lamp. The two parts of the instrument being thus prepared, the funnel is fitted to the body of the pipette, both are ground with emery, and the whole is luted with sirupy silicate of soda, or marine glue, applied hot. Finally, to the extremity of the pipette thus constructed is fixed a piece of rubber tubing with a Mohr clip.

(Fig. 1)

A NEW PIPETTE.

(Fig. 2)



A NEW BURETTE.

The instrument is used as follows: The pipette is grasped with one hand at the height of the cylinder, γ, and the air hole, δ, is closed with the finger, which should be moist or wet. Since the closing must be perfect, the point of the pipette is immersed to a depth of a few millimeters in the liquid. The operator sucks at ε with the mouth while opening the clip with the other hand. The liquid rises at α, overflows at λ into the cylinder, and the clip is then quickly closed. The pipette is exactly filled. The finger that closes δ is raised, the air re-enters, and the liquid flows out. After several operations, the cylinder, γ, is emptied of the liquid in excess, flows out through the air hole by inclining the instrument.

Industrial Burette.—Since the first burette or alcoholimetric tube, invented at the beginning of this century by Descroizilles, a large number of modifications of this instrument has been devised. The primitive burette of Descroizilles gave rise to the English burette. Then came the burette of Gay-Lussac and its derivatives—the burettes of Geissler, Koersting, Mangon, Houzeau, Casamajor, Nugues, etc. Dr. F. Mohr recommends the form of straight burette that bears his name, and from which are derived the burettes of Heriot and Biggs, Salleron, Pinchon, Sestrini, Gawalosk, Kleiner, Reischauer, Koenig, etc.

Mohr also devised a burette that fitted itself automatically. Lastly, various chemists have introduced this improvement. Such are the burettes with automatic bringing to the zero of Pellet, Sencier, Dupont, etc. Such burettes are very practical, but the maneuvering of them is slow, owing to the very arrangement of the bringing to the zero. In fact, in these instruments this result is attained by means of a tube arranged as a siphon, which, after having led the titrated liquid into the burette, automatically siphons the liquid in excess above the zero of graduation. Now, this tube being necessarily drawn to a point at its extremity, or, at least, of very feeble diameter, since otherwise the last drops of the siphoned liquid might fall back into the burette, the filling of the latter is quite a slow operation. Besides, if through inattention the burette be filled too full, it requires a certain time for the great excess of liquid to be expelled by the siphon.

In the burette proposed by Mr. G. A. Le Roy this defect does not exist. The liquid enters through a wide tube, and a large excess of it causes no possible retardation.

This burette (Fig. 2) is constructed as follows: A well calibered glass tube, α, of the desired length and diameter is taken. This tube is slightly drawn out at one of its extremities, λ. The slender part is cut off, and the cut section is passed upon the grindstone, so that it shall present a diameter of three or four millimeters of aperture. To the other extremity of the tube, α, is soldered a glass tube of smaller diameter. The tube, α, thus prepared, is passed into another tube, γ, of a few millimeters larger diameter. This tube is provided with an aperture at one of its extremities at δ. To the other extremity is soldered a tubulure, θ. By means of a lamp, the tube, γ, is soldered to the tube, α, a little below the tubulure, θ.

Finally, the tube, α, is connected with a tube, ε, of three branches through a rubber tube. This branched tube communicates, through two rubber tubes, at π, with a slender pointed tube and at μ with the reservoir, φ, of titrated liquid. These two tubes, π and μ, are closed by a Mohr clip. The tubulure, θ, acts as a waste pipe and is connected by a tube with a bottle at φ'. The apparatus thus arranged is fixed vertically upon a support. In order to effect the graduation, the liquid is allowed to enter through μ. This liquid rises at α, and overflows at λ into the cylinder, γ, and thence flows through θ. The clip is released. Under these conditions, a very marked convex meniscus forms. The zero division is marked at the upper level of the convex meniscus. A cubic centimeter, half a cubic centimeter, or one-tenth of a cubic centimeter is allowed to flow through the tube π, and the following division is marked at the level of the concave meniscus, which then forms in the interior of the tube. In the same way are marked the few following divisions until the ordinary diameter of the tube, α, is reached; then the graduation is proceeded with as usual. The graduations are engraved externally upon the tube, γ. The burette operates when the clip, μ, is opened. It fills immediately. The liquid overflows with force through λ, the clip is closed and the apparatus is at zero. There is nothing further to do than to titrate by opening the clip, π.

According to some comparative experiments, this burette operates with extreme rapidity.

BACTERIOLOGICAL CHEMISTRY.

In dealing with the literature concerning new branches of research, difficulty is often experienced by those who are not specialists in gaining a clear idea of the progress that has been made, the chief obstacle being undoubtedly the rapid growth and irregular development of an exact system of nomenclature. Existing words are used with new meanings in the earlier stages of growth of a new subject, and not until it has been fixed upon a definite basis, becoming susceptible to some degree of classification, are special terms coined and set apart by investigators. The editor of the *Boston Medical and Surgical Journal*, recognizing this difficulty in the case of bacteriological chemistry, has published a synopsis of the work that has been done, for the assistance of those who may wish to gain some knowledge of the lines upon which investigators are conducting their researches. This, with slight modifications, we now reproduce.

It has been demonstrated that all bacteria during their growth cause certain modifications in the media in which they are grown. These new products are known as ptomaines* and leucomaines.† The former are the products formed by the action of bacteria upon dead organized material, the latter are caused by the action of bacteria upon living tissues. This distinction is not always maintained, the term ptomaine being often used generally to designate the organic products of bacterial action upon organized tissue which is in a state of retrograde metamorphosis, that is, material which is being returned by the influence of bacteria to the elemental H_2O and CO_2 conditions. It is to be borne in mind that the ptomaines are not necessarily poisons. They are, however, such unstable compounds that a slight change in the arrangement or number of atoms may render an inert nitrogenous base actively poisonous, and *vice versa.* All the retrograde changes which an organized body undergoes have been demonstrated to be due to the action of bacteria, while moisture and warmth, which were formerly supposed to be causal in their action, are shown to be only favoring conditions under which thrive the bacteria producing the putrefactive and fermentative changes.

Pathogenic bacteria may act either mechanically, the capillaries of important organs being occluded by the presence of great numbers of micro-organisms and the functional power of the organs destroyed, or the bacteria may have a toxic effect on the whole system, or a local poisoning effect which destroys the tissues, as in certain surgical diseases. In the bacteriological diseases affecting man, the two forms of intoxication are the more prevalent.

The bacteria may cause such pathogenic conditions in two ways. They may have in their own bodies the substance which causes the action upon the tissues with which they come in contact. This is a substance known as *bacterial proteid*, to distinguish it from another proteid which will be spoken of later. The bacterial proteids are analogous to the active principles of plants, as strychnia, quinia, etc. In the second method, the active principle is produced by the bacteria during their growth, just as certain cells in the stomach during their growth produce pepsin, which, coming in contact with certain parts of the food in the stomach, has the power of changing its character, or, as we say, digesting it.

In whichever way the bacteria act, when the product of their growth attacks the living organism, it may simply act as a ferment, or, as it is called, an enzyme‡ upon the blood, causing a change in its character which renders it useless, if not poisonous, to certain cells of the body. These portions begin to show pathological changes, and if the cells are of sufficient importance to the organism, other cells or dependent parts suffer, and the organism may die. This is direct intoxication, or the result of the absorption of the poison produced by the bacteria themselves. But intoxication may also be due to the modification of the media in which the bacteria grow. Here the proteids or the ferments above mentioned may have only a local action on the tissues, but the modification of those tissues may result in the formation of some mid-product of retrograde metamorphosis—a ptomaine or leucomaine, or more specifically, a toxalbumen or poisonous albumose, alkaloid, or animal acid. If, now, this product of bacterial growth is absorbed, it acts upon the organism in an unfavorable manner, as in many mid-forms of digestion the peptones prove poisonous, if they chance to be absorbed.

It has been practically demonstrated that all the pathogenic bacteria owe their distinctive action to a toxic principle, and Koch's requirements for the establishment of specific action are, that a given form of bacteria shall always be present in every case, and that when cultivated outside of the body, and the pure culture introduced into the system of animals, the disease shall be reproduced, so that the bacteria may again be identified. To these it has been proposed to make the following addition: that the specific poison must also be extracted and be shown to be capable of producing the same disease in the absence of the bacteria.

The recognition of the importance of the toxic products of bacteria has caused bacteriologists to seek to discover some means by which to modify the action of the bacterial poisons, rather than to destroy the bacteria themselves. That this is a line which must be thoroughly investigated is shown by the fact that the blood and serum of both naturally and artificially immune animals does not necessarily have *bactericidal* properties, while the bacteria may even grow in their tissues and yet not produce any untoward results; making it plain that modification of the toxic products is the important factor. This leads us naturally to the subject of immunity, which includes both prophylaxis, or precautionary measures, and cure.

It is at present a working theory that bacteria in their growth cause the production of a material which is either hostile to their own development or acts as an antidote to the poison which they produce. This is brought about in two ways: first, by the production of the material from the media in which the germs are grown; and second, by the presence of the germs in the tissues calling into action the wandering cells, or leucocytes,§ the so-called white corpuscles of the blood.

* Ptomaine (*ptoma*, a corpse).

† Leucomaine (*leukos*, white). See *Pharm. Journ.*, [3], xxiii., pp. 7, 25, 43.

‡ Enzyme (*en* and *zyme*, leaven).

§ Leucocyte (*leukos*, white, *kutos*, a cell).

These, it must be remembered, have been clearly demonstrated, in accordance with the original observations of Virchow, to be composed largely of proliferating connective tissue cells, and that only in a small degree are they white blood corpuscles. Now the power of calling these wandering cells into action is a specific property of bacterial products, while it is not possessed by bacteria themselves; and this power of producing an inflammatory reaction in tissues is called the chemotactic* power of bacteria. Metschinekoff and his followers, while allowing this action to the bacteria, say that the chemical process stops here, the cells then devouring and destroying the bacteria, and that this phagocytic† action accounts for the recovery of the diseased animal. On the other hand, the German school, while they allow that the cells may and do exert a phagocytic action, if the bacteria themselves are present, yet as proliferation of the connective tissue cells can be brought about by the action of the chemical bacterial products alone, if repair and restoration, or cure, takes place, they argue that the process is due to an antidotal material—or, as it is called, the protective proteid, alexine or antitoxine—which may be the product of these cells. But, however it may be formed, the theory is that in each bacterial infection there is a corresponding antidote formed, which, if present in sufficient quantity, leads to recovery; if not, death of the part or of the whole organism is the result.

If recovery takes place, it has been observed that the patient is not generally susceptible to future attacks of the same disease. And further, that light attacks of certain diseases render the patient just as immune as do severe ones. Early in the study of bacteriology it was observed that certain changes in the conditions under which bacteria grew—as, for example, subjecting them to a much higher temperature, growing them under pressure or in the presence of oxygen, or passing them through another animal—modified their virulence. Putting these two facts together in the light of what was known about the relations of vaccination and smallpox, it was proposed to protect any susceptible organism from a severe attack of disease by the introduction of the attenuated bacteria, or by true vaccination. This was successful in hen cholera, anthrax in cattle, and swine plague, just as vaccination against smallpox has been successful. It was next found that when the chemical poison of the bacteria was extracted, vaccination with this was just as effective as when the attenuated virus was introduced.

Vaccination, however, is at best but a prophylactic measure, except in cases where the period of incubation is long. In these it is sometimes possible, by a process best described by the word acclimatization, to make the organism resistant by the use of rapidly increasing doses of the poison, so that at last the animal is able to resist the most powerful virus. But, on the whole, vaccination is in no sense curative. An active therapeutic measure is the great desideratum in many cases, and there seems to be a possibility of the problem being solved in the near future by the aid of bacteriological chemistry.

For a long time it has been known that some animals are especially susceptible to a given disease, while others never have the disease, or only have it when its specific bacteria are introduced in such large quantities as are unlikely to occur when the infection is accidental. When investigations indicated that the diseases were produced by the toxic action of the bacteria, and that there was present in the blood an antidote for each toxine, in the form of a protective proteid, probably produced by cell activity, the deduction followed that the naturally immune animals and those rendered artificially so by vaccination probably had those chemical substances normally present in the blood and that they were developed there by the action of the vaccine. If this should be so, then the serum of these immune animals will impart the desired curative agent directly to the blood. If, too, the nature of these protective proteids can be determined and they can be extracted from the blood, they can then be administered directly to the diseased organism, and so neutralize the cause of the disease. It seems probable that for certain diseases this is about to be realized, if it be not already done. The best and most effective work done up to the present is that of Behring and Kitasato on tetanus. Not only have they been able to render animals immune and to check the course of the disease when it was already well advanced, but successful application of the resistant animal blood serum has been made in a number of cases where human life was involved.

* Chemotactic (*chemosis*, inflammation, *taktos*, arranged).

† Phagocyte (*phago*, to eat, *kuto*, a cell). See *Pharm. Jour.* [3], xxii., 1004.

THE FORMATION OF ALUMINUM SULPHIDE.

By A. H. BUCHERER.

THE increasing employment of aluminum lends interest to the inquiry whether the present method of manufacture is likely to prove permanent or whether it will be replaced by a purely chemical process. The raw material is the oxide, from which the aluminum is prepared by electrolytic decomposition in a bath of fused cryolite. A comparison of the energy actually required to obtain one kilo. of aluminum with that theoretically necessary will throw some light upon the economy of the process. The preparation of one kilo. of the metal by Cowles process requires 44·5 electric hour horse power with a current of 3,000 amperes. Since now one hour horse power is equivalent to 636·8 units of heat, the energy used is equal to 28,337 units of heat. To this must be added 10 per cent. for the average loss in the conversion of mechanical into electrical energy, making altogether 31,000. On the other hand, the oxidation of one kilo. of aluminum evolves 7,260 units of heat. This will therefore represent the energy required to split up the oxide into metal and oxygen. The combustion of the positive carbon electrode, however, aids in heating the bath, and the energy of this change must be subtracted from 7,260, leaving in all 5,630 units. Hence only 5,630:28337 = ⅕ of the total electrical energy is employed in chemical, *i.e.*, electrolytic work, ⅘ are lost in the form of radiant heat. If we assume that the electrical energy is supplied by a dynamo driven by steam power and that on the average 7 per cent. of the potential energy of the coal is converted into mechanical energy, it is obvious how costly the use of electricity is when operations have to be conducted in a bath at a high temperature, and the question as to whether a chemical method of making aluminum is not even yet possible becomes of increasing importance.

The old process of Deville, consisting in the treatment of sodium aluminum chloride with sodium, can no longer compete with the electrolytic process, mainly on account of the cost of production of aluminum chloride. It can, moreover, scarcely be supposed that this will alter in the future. In the winter of 1890 an attempt of mine to electrolyze aluminum sulphide proved successful. Without referring here to this metallurgical work, I propose to describe the method of preparing aluminum sulphide which I discovered. Among all the methods proposed for this purpose the only one at present deemed successful is that of passing carbon bisulphide vapor over the oxide heated to bright redness. The latter reaction is represented by the following equation:

$$Al_2O_3 + 3\,CS_2 = 3\,CO + Al_2S_3 + 3\,S.$$

J. W. Richards, in his extensive work on aluminum, stated the equation:

$$Al_2O_3 + 3\,CS_2 = Al_2S_3 + 3\,COS.$$

Richards, however, overlooks the fact that carbon oxysulphide is itself decomposed at a red heat, while the formation of aluminum sulphide only takes place at a bright red heat. The carbonic oxide and sulphur certainly combine in the cooler parts of the apparatus, but that has nothing to do with the reaction itself. I observed that on passing carbon bisulphide over white hot alumina the excess of bisulphide was decomposed into carbon and sulphur, while the formation of aluminum sulphide proved to be most complete at this temperature. It appeared very probable, therefore, that at this temperature carbon and sulphur themselves would react with alumina in the sense of the equation:

$$Al_2O_3 + 2\,C + 3\,S = Al_2S_3 + 3\,CO,$$

and experiment confirmed the idea.

A clay retort of semicircular section, 0·6 meter long and 0·3 broad, was charged with a mixture of alumina and powdered wood charcoal, so that the mixture covered the bottom of the retort to the depth of 25 mm. The retort had a round opening, almost 4 cm. wide at one end, into which a clay pipe, sloping upward, and 0·6 meter long, was well fitted. This served for the introduction of the sulphur and the exit of the gases. The retort was then heated by oil gas to whiteness, and then portions of sulphur added at intervals of half an hour, so that the sulphur was always present in the retort in slight excess. The opening of the tube was partially closed, so that the gases passed out under slight pressure. The excess of sulphur vapor prevented the otherwise bad effect of an excess of carbon monoxide, for the law of the action of mass must be taken account of in an endothermic reaction such as the one in question. When much sulphur is added the vapors rise into the tube, condense and fall back into the retort. A large excess of sulphur must be avoided, on account of its great cooling effect. The conversion into sulphide is quite complete, provided that the operation is continued for a sufficient length of time.

An absorption of 180,500 units of heat takes place, the greatest amount yet observed for a reaction. Richards, in attempting to demonstrate theoretically that this reaction would not occur, states that it only takes place with carbon bisulphide, because 52,000 units of heat become free through the decomposition of one molecule of carbon bisulphide. Richards, however, neglects to consider that this heat can only act in the same way as heat supplied externally, and serve to raise the temperature. The carbon bisulphide aids the reaction, because the carbon at the moment of action upon the alumina is in the atomic condition. That this is also true for the sulphur is not so certain, because at a white heat we must assume that sulphur is in any case present in atoms.

This preparation of aluminum sulphide can be cheaply carried out on the large scale. When the sulphur is recovered I calculate the cost of manufacture of sulphide, containing one kilo. of aluminum, as 0·15 mark.

It may be mentioned that the electrolysis of fused aluminum sulphide renders it possible to use a furnace in which the loss of heat is less than in the one employed in the present process. The heat of formation of the sulphide is only one-third of that of the oxide, a fact which points to a relatively easier reduction. There can be no doubt, however, that the discovery of a chemical method of reducing the sulphide would be of the greatest industrial importance.

Although iron effects the reduction with formation of iron sulphide and ferro-aluminum, the product has hitherto been useless, on account of the amount of sulphur contained in it.—*Zeit. fur Angew. Chem., Chemical Trade Journal.*

DETERMINATION OF LEAD.

By LUDWIG MEDICUS.

IN operating upon galenas the author adopts the following method: After converting the lead into a chloride he dissolves the lead chloride in potassa lye, and passes a current of carbonic acid through the solution for two hours. The precipitated carbonate is filtered off, washed, dissolved in nitric acid, and the lead is precipitated electrolytically as peroxide.

He attempted also to precipitate the lead from the alkaline solution as peroxide by means of bromine. He succeeded best in the following manner: The chloride is dissolved in potassa lye; the solution is poured into a flask closed by a cork, with two perforations for the introduction and the escape of gas. A slow current of gaseous bromine is passed through the entrance tube *above* the liquid, which is gently heated. The bromine is readily absorbed and the lead is gradually deposited as peroxide. The filtration is best effected by exhaustion through finely elutriated asbestos placed between two disks of asbestos paper.—*Ber. Deutsch. Chem. Gesell.*, vol. xiv., p. 2490; *Chemical News.*

EXTRACT OF BEEF AND PEPSIN.

By JAMES T. SHINN.

PASSING through Chicago last summer, an opportunity was afforded for visiting the great packing establishment of Armour & Co., which is located among the famous stock yards of this metropolis of the West.

These stock yards by the way are worthy of a moment's notice. You take a train in the middle of the city and in half an hour arrive at the arched gateway inscribed: "Union Stock Yard, chartered 1865." Inside there are 400 acres of ground laid out with 20 miles of streets and water troughs, 200 acres of yards, 75 miles of drain and water pipes, and 50 miles of feeding troughs. There is capacity for the daily caring of 160,000 animals, cattle, sheep and hogs, and it is interesting to see the long rows of horses, with cowboy saddles on, tied along the sides of the streets ready to carry buyers and sellers to the different pens. About $5,000,000 are invested in the plant, and it requires 1,000 employes to handle the animals, which in 1890 numbered nearly 14,000,000, including horses and calves. It is one of the curious sights of the place to see the cattle lured from the yards to the slaughtering pen by a white decoy steer, "Old Billy," who calmly walks ahead of the drove and deftly turns aside at the entrance gate, while the rest rush in to their fate. It takes less than ten minutes to convert the live steer into a carcass of beef ready for the cooling room, and nothing from the tip of his horns to the last hair of his tail, inside or out, is allowed to be wasted.

Armour's works occupy about 54 acres within the inclosure, where the slaughtering, curing, manufacturing and packing of the various products are carried on to an extent of seventy million dollars per annum.

The making of extract of beef and pepsin has been added to the other industries and is of special interest to pharmacists. Under the guidance of Mr. Manwaring and Mr. Walton we were shown through this department, and saw such of the processes as were in operation.

For the *extract of beef* prime lean, well trimmed meat is finely cut up and digested with steam heat in huge wooden vats; the juice is expressed, filtered through muslin, and sucked into vacuum pans, each capable of reducing seventy-five cubic feet to the proper consistence in thirty-five minutes. The facilities for obtaining the best and freshest meat from the finest cattle are obvious, and the use of improved machinery insures the absence of all unpleasant burnt taste.

In the preparation of the various *pepsins*, they have the great advantage of an unlimited supply of *perfectly fresh* hogs' stomachs and can use from 10,000 to 14,000 daily. About two ounces are cut out of the whole stomach, the rest being rejected as inferior, the mucous membrane is scraped off and digested for six or eight hours in a dilute solution of muriatic acid, and by some peculiar process the *peptones* are eliminated, the solution clarified by settling at a very low temperature, and finally dried on glass plates. Saccharated pepsin is also made by Scheffer's process, and pepsins of various digestive power are put up for market.

With an experienced and capable chemist, who has unlimited material and capital to back him, there should be no reason why we should not be supplied with the very best products from an American laboratory.—*Am. Jour. Pharm.*

OIL OF COPRAH AND PALM OIL.

By ERNEST MILLIAU.

AT from 30° to 31° the oil of coprah, if pure, is soluble in twice its volume of absolute alcohol. At the same temperature palm oil is soluble in four times its volume of absolute alcohol. If mixed with sparingly soluble vegetable oils or animal fats to the extent of 1-20th, or less, both become almost insoluble in the same quantity of absolute alcohol, the solvent action of which does not occasion a fractionated separation of the component parts. The mixture has acquired a solubility which is peculiar to it, and which does not depend on the proportions of soluble and insoluble fatty matters of which it is composed.

These differences of composition enable us to determine with precision the purity of these solid oils, a chemical analysis of which often gives uncertain and even contradictory results, especially for slight admixtures.

METHOD OF OPERATION.

First Process.—We shake up for one minute, in a test tube graduated in c. c., 20 c. c. of the oil under examination with 40 c. c. of alcohol at 90°. This indispensable preliminary treatment may give certain indications. Alcohol at 95° absorbs a certain quantity of the neutral fatty substances, and the oil itself dissolves from 15 to 20 per cent. of alcohol. The solvent power of the oil decreases appreciably on the addition of insoluble oils, while that of alcohol increases by the addition of oils soluble in alcohol at 95°, such as castor and resin oils—oils which may then be easily characterized by their very distinct chemical and physical properties.

Second Process.—In a test tube graduated in c. c. we treat 5 c. c. of the oil of coprah (previously washed with alcohol at 95°) with 10 c. c. of absolute alcohol, and we place the tube in a water bath heated very exactly to from 30° to 31°. After some moments the tube is taken out, shaken very briskly for thirty seconds and returned to the water bath. Pure coprah oil dissolves entirely, and the alcoholic solution is perfectly clear.

Coprah oil mixed with insoluble oils (the commonest sophistication), arachis, sesame, cotton, maize, etc., does not dissolve appreciably, and forms a turbid mass with the absolute alcohol, from which it quickly falls in fine drops to the bottom of the tube, where it collects. Oil of coprah containing palm oil is precipitated when the proportion of the mixture reaches 20 per cent. Below that limit the mixture remains turbid.

The verification of palm oil is effected in the same manner, using 20 c. c. of absolute alcohol instead of 10 c. c., and operating always upon 5 c. c. of oil at the temperature of 30° to 31°.

Five c. c. of palm oil containing 20 per cent. of co-

prah or upward dissolves in 15 c. c. of absolute alcohol; in the same proportions the pure oil does not completely dissolve and the mixture remains turbid. The purity of coprah and palm oil cakes is found by extracting a sufficient quantity of oil by means of any solvent and treating in the same manner.—*Comptes Rendus*, vol. cxv., p. 517; *Chemical News*.

A NEW IMPROVEMENT IN THE PLATINOTYPE PROCESS.

By P. C. Duchochois.

Since the early ages of photography the attention of experimenters has been directed toward finding a simple process by which permanent positive impressions could be attained, none of the silver printing methods, either by development or the continuous action of light, yielding prints of certain permanency. Among the processes which were devised, Poitevin's carbon process and Willis' platinotype are the only ones which produce photographs that can be considered as absolutely permanent.

The carbon process is well known. In the hands of skillful operators it yields splendid proofs. But the manipulations are somewhat complicated, and for this reason the process has not been generally adopted. For the majority of amateurs it is, so to speak, out of the question.

There is, however, a modification of this process which renders it exceedingly simple; but then it can only be employed to reproduce designs in lines any white and black subject. It is as follows:

A sheet of albumenized paper is sensitized from the back by spreading over a 3 per cent. solution of potassium bichromate, which is allowed to penetrate through the paste of the paper. When dry, it is exposed under a negative for a few minutes; then on the albumen surface one brushes, by means of sponge, a thin coating of printing or lithographic ink, thinned with turpentine. When the turpentine is partly evaporated, which requires four or five minutes, the print is placed into cold water, and after a period of, say, a quarter of an hour at the utmost, by brushing gently with a soft wet rag, the albumen not acted on by light is washed out, and a proof in greasy ink is obtained, which only needs soaking in water to eliminate the bichromate from the paper and to obtain pure whites.

By the platinotype splendid proofs in half tones are obtained, provided the negatives are specially made for that purpose.

As originally devised by Willis, and improved by Pizzighelli and Hubl, who made a complete study of it, the process offered some difficulties, not on account of the photographic operations, but on account of the preparation of the sensitizing compound; and, therefore, the professional and amateur photographers preferred buying the paper already sensitized rather than to prepare it themselves; moreover, until lately, the process was patented. Now it is public property, and already several improvements, to render the process entirely practicable, have been published. Among them we find one not only very simple, but also economical, which M. Ganichot has communicated to a French paper, *La Science en Famille*.

This process is as follows:

To prepare the sensitizing solution, 125 parts of dry ferric chloride are dissolved in 1,000 parts of distilled water, and the solution filtered. The iron is then precipitated as a hydrate by aqueous ammonia added in excess. This done, the precipitate is washed in five or six changes of water, thrown on a filter to drain, and then dissolved in a boiling solution of 50 parts of oxalic acid in 150 parts of distilled water by adding it in small quantities until the solution is saturated and there remains an excess of oxide; for, according to Mr. Ganichot, it is necessary that the solution be neutral and saturated.

After filtration 2½ parts of sodium chloro-platinite are added, and the solution, being diluted to 250 parts with distilled water and filtered, is ready for use. If sheltered from the luminous action, that is, if kept in perfect darkness, in a well-stoppered vial, it will undergo no alteration for a long time.

As usual, the paper for the platinotype process should be sized either by arrowroot or gelatine. We have used with success the coated paper employed in the collodio-silver chloride process. It is easily found in this market and it is cheap.

The sensitizing should be done in the dark room lighted by a yellow light, spreading the platinous mixture as equally and evenly as possible with a Buckle's brush.

It is important, says Mr. Ganichot, that the solution should not soak in the paper, else the image will be sunk in and without brilliancy. He also directs the suspension of the sensitized paper by one corner and allowing it to dry thus. This we find objectionable, and we advise the reader to desiccate the paper by heat as soon as it is surface dry. It is then ready for use.

Under a negative of ordinary intensity, the image appears rapidly. The image should be printed until it is visible in all the details, when the proof is removed from the printing frame and developed in the dark room or by a very diffused daylight.

The development is made by immersion in a solution of—

Oxalic acid	25 parts.
Sodium chloro-platinite	2½ "
Water	250 "

The image appears rapidly, increases in intensity and (partly) loses the reddish yellow tint due to the ferric oxalate.

The sodium chloro-platinite added to the developing solution is useful; it gives up the platinum necessary for the complete formation of the image, the quantity held in the paper not being sufficient.

As in all the printing processes, the development should be stopped when the image has acquired the proper intensity, for it loses nothing by the subsequent washings. Mr. Ganichot does not state whether the washing should be first done in an acid solution. But it is evident that it should be so, to entirely eliminate the iron salt and thereby to obtain pure whites. Therefore we advise a preliminary washing in a 2 per cent. citric acid solution, twice renewed before the final washings in pure water.

This process, exceedingly simple and by no means expensive, possesses the advantages of yielding proofs without exaggerated contrasts, and, besides, states Mr. Ganichot, owing to the use of the sodium chloroplatinite, the paper is not affected by dampness. In this we do not agree with the author; the salts of iron, notably the bichromates, act on organic matters even in the dark, and the photo preparations in which they are present lose their good qualities in a certain period. Moreover, generally the ferric salts, the oxalate, for instance, are always more or less hygroscopic, and dampness, as it is well known, should be avoided in the platinotype process. Hence it is advisable, not only to desiccate the paper soon after it is sensitized, as has been said, but also to keep it in a chloride of calcium box, similar to that used for silver albumen paper.

We must also observe that the platinum paper gives the best results when it is newly prepared; and, as the preparation is very simple and expeditious, it will be well to prepare only the quantity of paper for one or two days' use.

"Notwithstanding the constantly increasing price of platinum, the process is yet economical, for the quantity of platinous chloride entering into the preparation of the paper is small, so that the proofs, when finished, cost hardly one-quarter as much as those obtained by the silver printing-out process, and they possess the inestimable quality of being unalterable."—*Anthony's Bulletin*.

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